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J. C. HENRY.

Death has been active in electrical ranks lately, and now has removed from among us John C. Henry, whose name must ever be included among those of the men who helped to create the great modern electric railway industry. Out on the Western frontier he discovered many things for himself that had he been in the East would have made no little noise in their day, and had he enjoyed better health his later years would doubtless have been as productive of ideas and improvements as his old days of pioneer inventing in a raw region of a new country. Considering his opportunities, Mr. Henry went far.

HEAVY ELECTRICAL MANUFACTURING.

So far as we can ascertain, all the electrical factories are busy and prosperous, although, of course, prices in some respects might be better. But an order for three million dollars' worth of apparatus, such as went to the General Electric Company last week, for the Manhattan equipment, is still unusual enough to attract and deserve special note. As time goes on, and more of the domain of light, power and traction is conquered by electricity, especially the branch which concerns main railroad operation, these orders will assuredly become larger and more frequent. We note also this week some very heavy Westinghouse work, of which the news is now made public for the first time. Not only is this work interesting from its very magnitude, but because, as will be observed from a perusal of the article, it is all virtually special. Now, one of the characteristic features of American electrical work of late years has been that it was principally standard as contradistinguished from special; and one of the reasons assigned for leadership over Europe in production was the fact that nearly every European equipment was individual. But here in these immense Westinghouse machines, it will be seen that the tendency is to build specifically for the conditions, rather than make the order fit the standard apparatus. How far this tendency can go without increasing cost of production is a question of no little moment, but it is offset by great skill and economy in processes of manufacture. The growing size of these units is also a remarkable fact, the generator as it gains in capacity being kept company by the rotaries and motors to which it furnishes current. There are many motors now running which are bigger than the generators once deemed riskily large for central power plants, but they operate smoothly and efficiently, and nobody bothers about them.

PROTECTING NIAGARA.

The news that the Niagara Power Company is now to develop its work on the Canadian side of the Falls will doubtless be noted with horror by those who would leave the great cataract alone in its glory, without the touch or stain of any human industry. But as a matter of fact, there is an awful exuberance of rhetoric over the "destruction of the Falls," and those who are trying to reclaim part of the energy that has been wasted for years, have to endure no small amount of obloquy. It is, of course, true that some of this utilization is unnecessarily and sinfully ugly, but it is not worse than Nature often wreaks on her own domains. Of the later plans for getting power from Niagara, away from its finest scenery, it can only be said that they are both scientific and preservative of her beauty. In reality, a stiff wind up the gorge does more to keep the

Falls dry than man will be able to do in the next 50 years; and God Himself in one frost does more to break down the cliff over which the river plunges than man can do in a thousand years. The present work, indeed, by diverting part of the water is tending to preserve the Falls, a view of the subject we venture to commend to the *Outlook* and its contributor, Miss Hartt, to whom we venture to deny a love of natural grandeur and scenic beauty in anywise superior to our own.

Telephonic Growth.

We have had the pleasure of publishing recently some articles on the development of telephony on the Pacific Coast, the third of which appears in this issue. As illustrative of the ideas and methods of the man who has on account of their success just been advanced to one of the most important positions in the Bell telephone service, these articles have an unusual value. It is always interesting to know how any success is achieved, although the secret is apt to elude the observer even in the telling. It is obvious, however, that Mr. Sabin has had at least two great virtues. He has lots of push, and he believes in advertising. He knew he had a good thing to push, and he left no opportunity untried for getting new business. Neither did he neglect the technical side of his art, for while proclaiming the utility of telephony he did all in his power to render the service cheap, swift and efficient. That he has his reward and that the people of the Pacific Coast have the best all-round telephone service in the country, need not therefore awaken surprise. To see how Mr. Sabin succeeds in the Central States will now be an exceedingly instructive study. The public there is certainly destined to be the beneficiary of the keen struggle between him and the independents, who have been building up a great network and doing admirable work from Indiana to Iowa, and from Minnesota to Missouri. It would be a pity, however, to see the competition degenerate into a mere money-losing contest on the part of the rivals, for when in the long run one or the other system rules supreme, as it probably must, if the old theories stay good, then the public will as usual have to foot the bill for all the losses incurred in the meantime. The situation is indeed of striking interest to all engaged in telephony

Electrical Engineers Under Fire.

The pages of the *Journal* of the British Institution of Electrical Engineers contain an account of an attack made upon a party of electrical engineers engaged in reconstruction, railroad and telegraph work in South Africa last June. This appears in a paper read by Colonel Crompton, who had charge of the corps. Several of the men were killed in the attack, which was made under De Wet, who summoned the party to surrender. The electrical engineers, forming about one-third of the available force, defended themselves so well that the Boers drew off, after making a few prisoners.

One of the most interesting features of the paper is the evident value of the steam traction engine for use in military and particularly in artillery field operations. It is stated that with the aid of a traction engine a 12½-ton gun was hauled to an elevation of 1300 ft. up a mountain, over an average slope of 10 per cent. A number of interesting photographs accompany the paper. The scene of the attack is photographed after the Boers had withdrawn, and a photograph is also shown of two men firing their rifles from a railway van. The enemy is, however, evidently supposed to be at a conveniently considerable distance. In getting to the "front" our English cousins were more fortunate than those of us who went under General Griffin in the Volunteer Engineer Regiment to Puerto Rico, hot for the fray, and on getting there found there was a front without a firing line. Our boys had all the ardors of the campaign and none of its bloody fun.

The Paris Exposition Moving Sidewalk.

A full description of the conditions which had to be met in the erection and operation of this well-known sidewalk appear in the January number of the *Bulletin de la Societé Internationale des Electriciens.* It was at first proposed to drive this sidewalk by three-phase motors. It seems that the difficulties feared lay in the simultaneous starting of all these 170 machines. The starting torque of the sidewalk was, in fact, nearly three times the full-load running torque. It was feared that in order to provide sufficient starting current, the power station which was also a large electric lighting station, might suffer to the extent of seriously affecting the pressure regulation on the lighting circuits. For this reason the plans for installing three-phase motors were abandoned, and direct-current motors employed, using converters at the sub-station. Some of the plans proposed for starting the three-phase motors in order to meet the starting difficulty, are ingenious and interesting. The road as operated has been very fully described and illustrated in these pages.

Alternating-Current Meters.

In the current number of the *Bulletin de la Societé Internationale des Electriciens* appears an interesting paper by M. Janet, upon the electricity meters which were exhibited at the Paris Exposition of 1900. While but little change has manifested itself in the art of constructing and designing direct-current meters during the last decade, there has been a considerable increase in the number and vaviety of alternating-current watt-hour recording meters. Of those which were exhibited at Paris, of 1-kw capacity, as noted by M. Janet, it seems that the average no-load waste or consumption was very little in excess of 3 watts, while the average starting current for the same size of meter was a little less than 90 milliamperes. This represents a very marked improvement in recent years. When the first altrnating-current watt-hour meters were produced and used in this country, they usually consumed about 16 watts, or more than five times as much as the above average; in fact, the principal objection to the meters of that time was the large annual amount of energy collectively wasted in their shunt circuits on an electric light system.

The principal existing objection to recording watt-hour meters lies in their initial friction, whereby they underindicate on light loads. Ninety milliamperes of starting current is satisfactory enough, but such results are more likely to be obtained with new instruments under laboratory tests, than with instruments that have been installed for several years under commercial conditions. In most of these instruments, a few turns of shunt winding are applied to the series field coils, so as to give the apparatus an initial starting tendency. The danger of this proceeding, which is theoretically excellent, is that in buildings subject to mechanical vibration from passing vehicles, or from working engines, the tremor may cause the instrument to start without any load, and thus to produce an unduly large bill. This creeping of meters may give rise to a serious error in the course of a month, and is objectionable, since it is almost sure to be detected by the customer, and to weaken his confidence not only in the instrument but also in the supply company. On the other hand, if no shunt turns are employed, increase of friction is apt to take place with time, to the undue diminution of the bills, and the leakage of power through the meter in the case of a very small load, steadily maintained, may be considerable.

A peculiarity to which alternating-current watt-hour meters are

subject, is the tendency to underindicate on low leading-current power factors. This is due to the small inductance in the shunt winding, which is assumed to be non-inductive, whereby a small lag occurs in the shunt current. This has a negligibly small effect upon the indications of the instrument on ordinary non-inductive load. If the power factor of the load is markedly reduced with leading currents as on condenser loads, the error established by this small lag may be very considerable. Such loads are, however, rare.

An ingenious means for reducing this error, when it is likely to make its appearance, consists in placing a short-circuited turn, or coil, within the series field winding, whereby a small induced magnetic flux is set up, tending to cause the resultant field flux to lag. The lag so produced can be adjusted into substantial equality with the lag in shunt circuit, so that the two are restored to their proper cophasal condition.

In alternating-current meters of the induction type, the correct phase relation between the shunt and series currents is quadrature, instead of cophase, and the corresponding error in these instruments lies in the imperfect quadrature phase relationship on non-inductive load, such that on a reduced power factor the error becomes very noticeable. Several ingenious methods are described for compensating this error, and restoring the required normal quadrature between the series and shunt fluxes.

LIGHTNING PROTECTION.

The season draws nigh in which the station manager begins to think of the "wrath to come," and furbish up his lightning arresters. As lines have grown longer and voltages higher it has steadily grown harder to deal with lightning, until at the present time lightning protection is one of the most serious problems that confronts the electrician, especially in cases of the long power transmission lines in a mountainous country. So long as voltages were low and distances short ordinary means sufficed to secure a certain degree of immunity from damage, but modern conditions are quite otherwise. Some there are who, when the question is raised, tiptilt the nose of scorn towards the source of fulminations, and suggest that if all lines were underground all would be well. Others intimate that if their particular form of patented arrester were used, lightning would come across three counties for the pleasure of coursing over them to earth; and still others consign all arresters to a region where, we trust, electricians will be scarce, and pin their faith to barbed wire. Now, even the first-named remedy, drastic as it is, hardly strikes one as a panacea in view of the fact that during the late brush with Spain, a couple of submarine mines in the Potomac region were simultaneously exploded by lightning during a single storm in spite of the fact that they were in independent groups attached to separate cables. As to remedy No. 2 the scrap heap raises a voice of dissent, while as to the third, sometimes it works and then again it doesn't.

Seriously, we know of few matters more deserving of careful study and experiment than the protection of high-voltage lines from lightning. No solution of the problem as yet presented seems to be in any way general enough in its applicability, and lightning is today about the most serious menace to continuity of service that the station manager has to fear. Let us analyse the conditions a bit and see where the matter really stands. Lightning discharges, as manifested on aerial lines, are broadly of two kinds: First, direct strokes from the thunderbolt, taking the line as part of its tremendous leap to earth; and, second, induced discharges or those springing in various forms from violent changes of air potential, either with or without a lightning stroke, properly so called. From the practical standpoint, these two classes vary mainly in their severity, the former being much less frequent but much more to be dreaded than the latter. In either case, the problem is to divert the discharge to earth so that it may not work havoc with the insulation of lines or apparatus, including, of course, the arresters themselves, which must remain ready for action at all times. In continuous-current systems the task is comparatively easy, for one can pile up reactance enough to be practically impenetrable so far as lightning is concerned, and fairly drive the intruding discharge to earth. If the current attempts to follow, it can quite easily be checked before it has time to do material damage. But with high-voltage alternating lines the case is very different. Reactance can be and is used with great advantage, but it can be employed only to a limited extent without interfering with the regular service, and it is far from easy to break the following arc. On polyphase lines in particular there is an excellent chance of the lightning starting a discharge across two phases followed by an arc with the full force of perhaps a thousand kilowatt-machine behind it. In this case the most carefully schemed methods of preventing or breaking the arc are very apt to fail, and something comes to grief suddenly. At best, there is a temporary short circuit, and the results may be far more serious.

To protect the generating apparatus the natural tendency is to make the arresters rather tender, i. e., with spark-gaps to an amount just sufficient to hold up the maximum working voltage. If much in excess of this amount, there is a very fair chance of lightning getting by them to the apparatus. But, on the other hand, tender arresters are apt to be hypersensitive and respond frequently to trifling disturbances due to resonance, or to the so-called static discharges—a name which covers a multitude of sins. And these minor affairs may cause frequent and annoying short circuits. Now the lesson which we wish to draw from this state of things is the necessity of intelligent study of the local conditions and adjustment of the arresters. It does not do to order and put up in blind faith even the best system of arresters yet devised—if anybody could name it. The careful electrician should know his arresters as he knows his switchboard, and particularly should know by cautious experiment at just what voltage the spark-gaps will break down. He should know, too, just how much his line will do at all seasons and stages of load in the way of abnormal sparking distance, and how far he can trust his arc-breaking devices. Most of all, he should have his arresters where they can be frequently cleaned, tested and inspected. We have seen the arresters on a 10,000-volt circuit stowed away in a wooden wire tower where the condition of the spark-gaps could not be examined even in clear weather without imminent danger to the investigator's life. Such construction cannot be too strongly condemned from every point of view, and it is pretty certain to defeat the object for which lightning arresters are installed. The main problem in the improvement of such apparatus is to develop an entirely reliable means for stopping the arc which may follow a discharge, and to arrange the apparatus so that it will, to a certain extent at least, discriminate between trivial static effects and really dangerous lightning. The former matter has been the subject of many inventions, some of them of great merit, but none quite what it should be. The latter subject will bear considerable study and experiment. But in the last resort much has to depend on the man on the ground, who should know his system from end to end, where and what the dangers are, where barbed wire will help him and where it will not; how much his arresters will stand and where they may play him false.

Heavy Machinery from the Westinghouse Works.

That the electrical manufacturing industry in all of its branches is enjoying a period of unexampled prosperity is plain to every one who would see, but the extent of the manufacturing operations incident to this situation is doubtless little realized by those who do not have opportunities for direct observation. Such an opportunity was recently afforded the writer by a visit to the East Pittsburg Works of the Westinghouse Electric & Manufacturing Company, which, though recently greatly enlarged and now employing 7000 men, are barely equal to the demands upon it to which the present era of prosperity has given rise. As an illustration of the magnitude and character of some of the work now in hand, a list of several of the more important recent contracts will be given further on. Lack of space at present prevents us from giving details concerning the apparatus mentioned, but it should be noted that most of the large generators are of special design. This fact renders an inspection of the Westinghouse factory at the present time of particular interest to the technical man, for many of the larger machines contain new features of special interest, an account of which we hope to give shortly in these columns. The departments manufacturing standard types of apparatus are also congested with work. The railway motor department, for example, is turning out machines in enormous numbers—more than 8000 equipments being called for alone in the orders of which mention is made below.

It goes without saying that the very large proportion of special work now under construction at East Pittsburg, usually of enormous size, has severely taxed the engineering staff and the works' management—the former in the preparation of designs of apparatus of progressively increasing size and special requirements, and the latter in devising for its execution workshop arrangements of a kind and magnitude far beyond what can be obtained by purchase from makers of workshop equipment.

When less than six years ago the enormous works at East Pittsburg were completed, there could have been little thought that its facilities would soon prove inadequate for the handling of the largest electrical machinery. This nevertheless has come to pass, and a large addition to the factory has, as a consequence, been necessitated. The main building, recently lengthened from 745 to 1200 ft., has a height of 67 ft. in the main bay, but the crane headroom was found insufficient for the Manhattan generators. To provide for the emergency thus created and also for the future, an alley way about 80 ft. wide between the main building and a line of storehouses has been roofed over, and a powerful traveling crane installed, which provides considerably more head room. In designing the original factory, future requirements as to size of electrical machinery could only be surmised, but as the castings of some of the large machines now under construction have reached the upper limit for railway transportation, the new buildings, being planned for these, can with more confidence be expected to prove equal to future demands—at least over an extended period.

A considerable part of the machinery to be used in the new bay will be portable, the machines being moved to the work instead of the work to the machines. To provide for this condition several large sections of the floor of the building are in the form of a metal bedplate with the usual grooves for holding-down bolts. Some of the portable machine tools have been fitted up in the factory, and all will be driven by induction motors, which are installed within the base casting of the tools; the disproportion between the size of the motors and that of some of the enormous tools forms a striking illustration of the advantages of the former for machine tool operation by direct connection.

An interesting feature of the design of the new generators of large size is the evidence given of a reversion to the simplicity inherent in electrical machinery. The 5000-hp Shawinigin revolving-field generators, for example, are in appearance in striking contrast in this respect with the Niagara generators of the same power, both field and armature being plain ring castings, with dovetail grooves for the field and armature laminations.

The largest work now under way is part of the order for the Manhattan Elevated road, the amount of which will aggregate about $5,000,000. The items are as follows: Eight 5000-kw, 11,000-volt, three-phase generators; 26 1500-kw rotary converters and 78 500-kw step-down transformers. The castings for one of the generators are now on the floor. The stationary armature is cast in six sections, the largest of which weighs 90,000 lbs., and the smallest 25,000 lbs. The parts of these machines are so large that owing to the limitations of railway transportation, they will have to be assembled in the power station at New York. Owing to the design of the machine this, however, will be a relatively simple matter. Both the field and revolving armature laminations dovetail in the castings and the windings will consist of large copper bars. The portable tools used in planing off the surfaces of the castings weigh about 25 tons. The casting is secured to the bed plate above referred to, and the tool then transferred by the overhead crane in position, where it is also clamped and is then ready for operation.

Another large order now under way is for the St. Lawrence Power Company, comprising 15 5000-hp, 2200-volt, three-phase rotating field machines. One of these generators is almost finished. An order from the St. Louis Transit Company called for four 2250-kw, direct-current, 550-volt railway generators, three of which have been completed. This order also included 750 motor equipments.

Castings are being made for four 2700-kw, three-phase, 6600-volt revolving field generators for the Brooklyn Heights Railway Company. The order from this company also includes three 2700-kw railway generators; 126 150-hp elevated railway motor equipments; 1700 55-hp street car motor equipments; 11 1000-kw and 5 500-kw three-phase rotary converters; 39 400-kw and three 200-kw air-blast transformers.

One 2700 575-volt direct-current generator for the Boston Elevated road is now under way, and two others are to follow. The order from the Boston road also included 200 250-hp motor equipments and 2500 motor equipments of various sizes.

The first shipment of a large order from the New York Gas, Electric Light, Heat & Power Company will be made in September. This order is for 10 1000-kw and two 500-kw, six-phase rotary converters; 30 400-kw, 6 200-kw and 3 200-kw air-blast transformers, and 3 100-kw oil-insulated transformers. An order for two 2850-kw, three-phase generators for the Kings County Traction Company has just been completed, and one of two 3750-kw generators for the Shawinigin Water & Carbide Company has recently been shipped.

An order for seven 1500-kw railway generators for the Union Traction Company, of Philadelphia, is nearing completion, six of the machines having been shipped. The order from this company also includes five 750-kw railway generators and about 2500 complete 50-hp car equipments. One 2000-kw and one 1050-kw railway generator for the Toledo Traction Company are under way, and one 1050-kw machine has been shipped. The order from this company also included 214 50-hp street railway motors.

Among other large work under way are the following: One 1050-kw railway generator for the Scranton Railway Company; also 238 40-hp motor equipments for the same. A 1000-kw, two-phase, 1040-volt revolving field generator for the Northern Ohio Traction Company. A 1500-kw railway generator for the Detroit United Railway. A 1000-kw revolving field, 220-volt, three-phase generator for the Wheeling Steel & Iron Company.

Electrical Apparatus in India.

Mr. R. F. Patterson, United States Consul-General at Calcutta, writes the State Department under date of March as follows:

"The following clipping from the *Calcutta Englishman* of March 9, 1901, shows a possible opportunity for our manufacturers of electrical machinery to secure the contract for the proposed electric plant in Lahore, the capital of the Punjab.

"Mr. Arthur Gray, barrister at law, and Mr. F. C. Remington, Bombay Tramway Company, are negotiating with the Lahore municipal committee for a concession of the monopoly of the supply of electric light and power within the municipal limits, for 30 years, on the general lines of the Calcutta concession. Their proposals also include an electric tramway line between the city and the railway station, with a possible extension to Mian Mir. The municipal committee has agreed to enter into negotiations, provided that local government concurs and that satisfactory guaranties and an agreement on the general lines of the Calcutta license be entered into."

Besides Lahore, which has a population of about 200,000, the following large cities of India have no electric plants: Madras (260,000), Delhi (115,000), Lucknow (150,000), Allahabad (100,000), Agra (200,000), Sawnpore (120,000), and Benares (225,000). Madras, it is true, has one for tramways, but not for lighting.

Electric lighting, though only introduced into Calcutta last year, is coming into general use. A contract has also been let for changing the tramways from horse to electric power.

Features of Pacific Coast Telephony.

THE rapid development of telephony on the Pacific Coast has been made the subject of two recent articles by the present writer, who notes as an interesting coincidence the prompt promotion to work in the Central States of President John I. Sabin, who has been the inspiring leader of Bell activity in California and the adjacent States. The writer believes that further details of Mr. Sabin's work will therefore be of timely interest, and presents herewith some further jottings from his notebook, on features not previously discussed.

In the main office exchange at San Francisco of the Pacific States Telephone Company the method of handling long-distance calls is of considerable interest to visitors. When a local subscriber in San Francisco wishes to talk out of the city he calls for "long distance," and the operator connects him with a long-distance clerk in the main office long distance-room. The long-distance clerk makes a written memorandum of the town and party wanted and the calling subscriber's name and number. This ends the long-distance clerk's connection with the message. She then puts the memorandum on an endless conveying belt, which drops it in front of the proper operator, and when the operator secures the desired connection she calls up the local subscriber wanting the connection. The essential feature to the successful and rapid handling of messages in this way is the endless belt machine. The long distance clerks occupy an elevated booth in the center of the long-distance room, as shown at the right in Fig. 1 and at the left in Fig. 2. From this booth or balcony the conveying belts radiate to the different operators. The conveyors consist simply of two belts running back to back, which carry the memorandum slip between them. It is an exceedingly rapid method of conveying messages, as the clerk has only to hand the messages to the conveyor and they are delivered at the proper operator's desk in the short time it takes the belt to travel that distance. The connection desired and party calling is down in black and white, and the plan works excellently and without confusion.

The telegraph is used very extensively by this company on its long-distance lines. The telegraph instruments are connected to the middle point of a retardation coil or coils bridged across the lines, the other terminals of the telegraph instruments being grounded. In some cases the telephone is connected the same way on short lines.

FIG. 1.—WEST PART LONG-DISTANCE ROOM, SAN FRANCISCO.

Most of the company's own business over the long distance lines is done by telegraph, so as not to interfere with the regular long-distance telephone business.

The business in San Francisco is divided among eight exchange offices. Main office, 8631 subscribers; West, 3379; East, 2748; South, 2567; Mission, 1974; Park, 1704; Butchertown, 64; Chinatown, 257; total, 21,324. Some of the exteriors and interiors have already been shown.

Fig. 3 is a unique feature of the telephone business in San Francisco, the Chinatown exchange. This exchange is patronized and operated entirely by Chinamen. On Jan 31, 1900, it had 257 subscribers all on individual circuits. The Chinaman has no use for party lines. Another peculiarity of the Chinese character is shown by the fact that it is next to impossible to get them to use numbers in calling for a connection. They give names and the operators must carry the Chinatown telephone directory in their heads. Not only must they remember the names and numbers of subscribers, but also the names of ten or a dozen employees or neighbors that are likely to be within reach of each telephone. However, the Chinese operators seem to be equal to the task. The interests of the Chinatown exchange are looked after by Loo Kumshu, a Chinaman of ability, who has the confidence both of Chinatown and the company.

FIG. 2.—EAST PART OF LONG-DISTANCE ROOM, SAN FRANCISCO.

FIG. 3.—CHINATOWN EXCHANGE.

An interesting feature of the main exchange in San Francisco is a small exchange board by itself, formerly known as Buyers & Sellers Exchange, and now designated as Business Exchange No. 1. Angeles, the Business Exchange is limited to 100 subscribers at $3 per month, and at San Francisco 150 subscribers. In making up an exchange of this kind the company is guided by the recommenda-

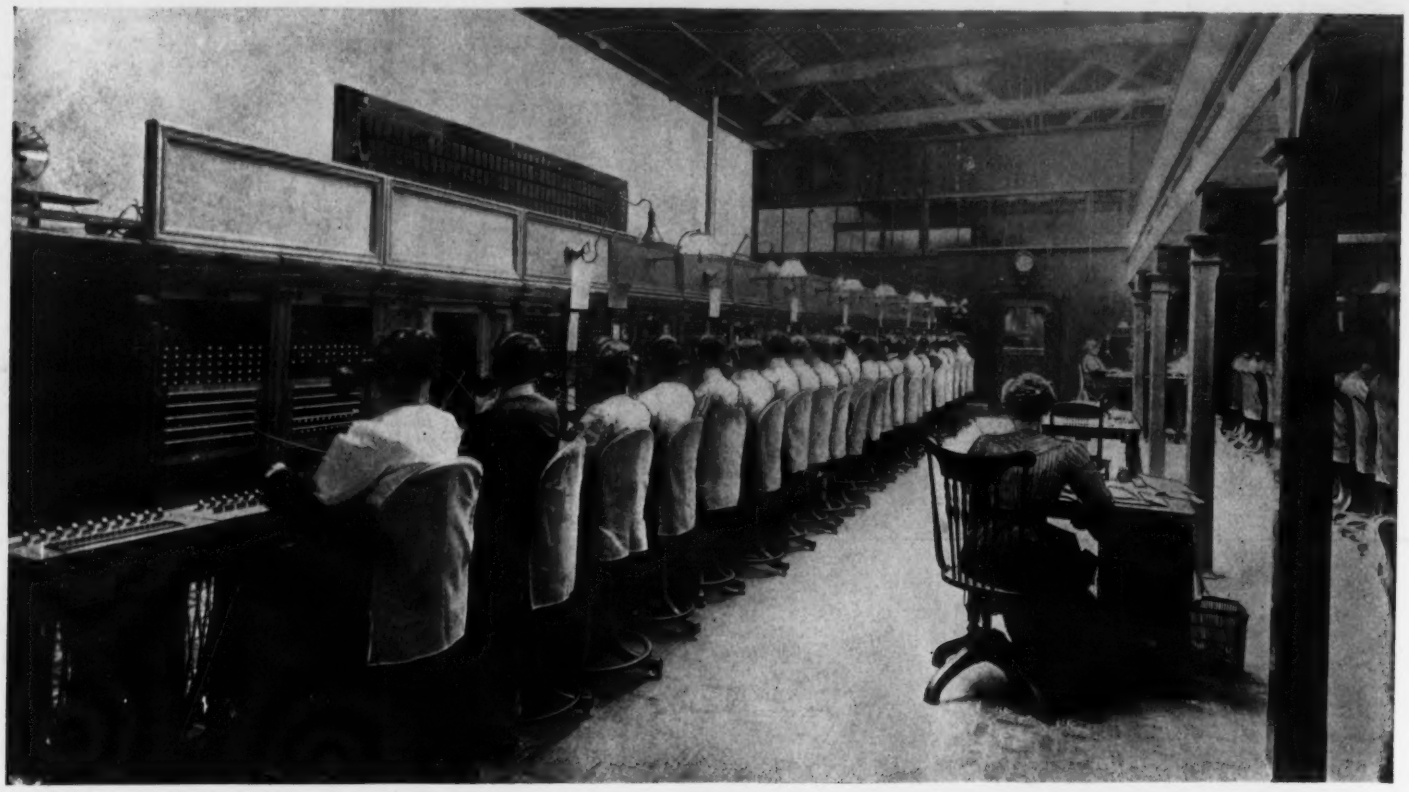


FIG. 4.—MAIN OPERATING ROOM, LOS ANGELES.

At Los Angeles there is also a similar feature. Its idea is to group together on one small board a number of firms who have a large amount of business with each other, and who wish instantaneous tions and wishes of the subscribers to the exchange. The idea is to get men together who want to talk to each other frequently.

The two sides of the party lines are given different designations

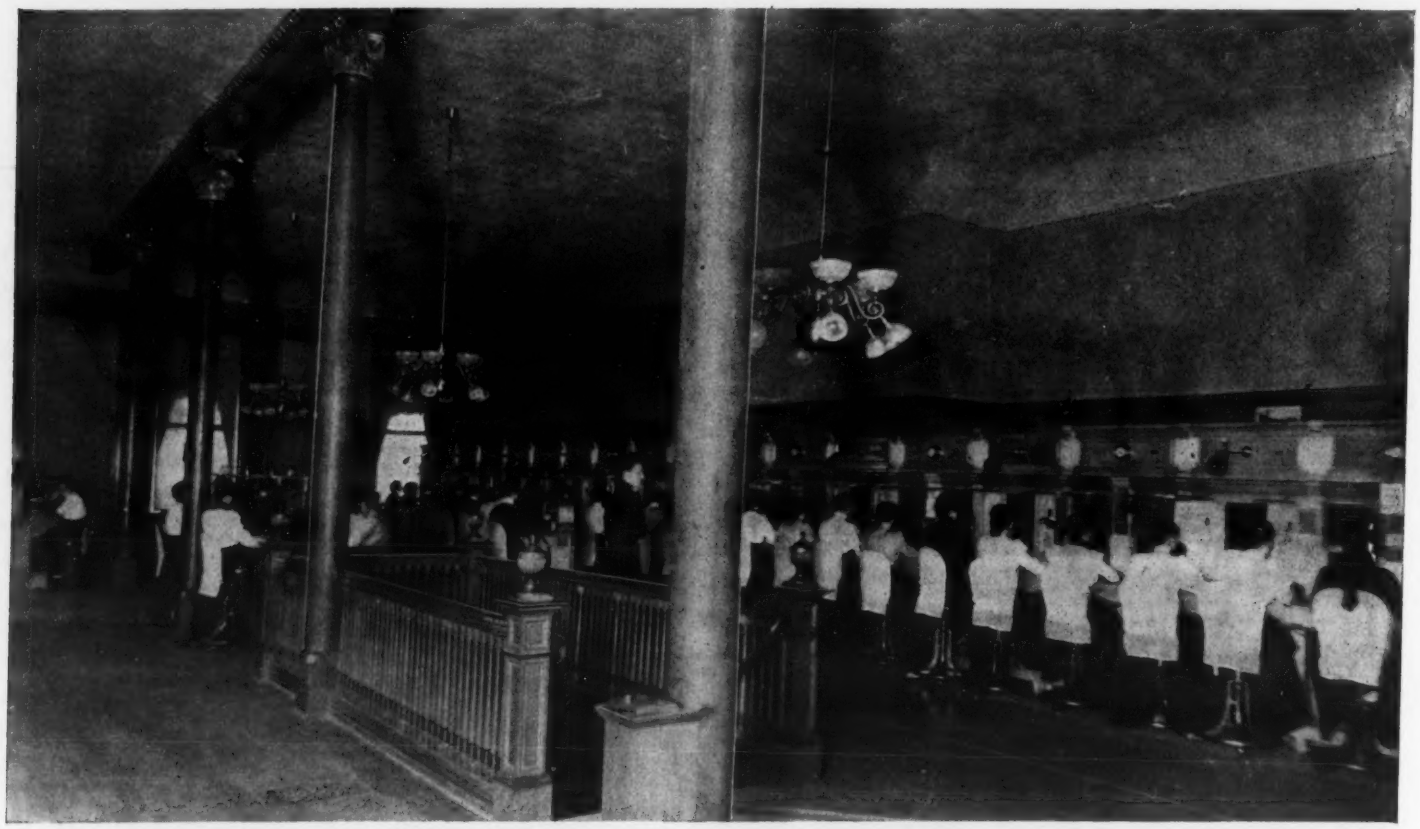


FIG. 5.—MAIN OPERATING ROOM, SEATTLE.

connections. The Business Exchange telephones are offered at a low rate, and have no connection with the other part of the exchange. The object is to afford quick connection and low rates to a class of firms having much business with each other. At Los in different branch exchanges. As colors soon gave out as designations, the names of streets in the vicinity of a branch exchange are sometimes taken, thus red and white would be the designation in one exchange and Polk and Larkin in another, for example.

In addition to the exchange switchboard already shown, Fig. 4 is one-half of the main operating room at Los Angeles, where a mixed board is used, as at San Francisco, but lamp signals are used at Los Angeles. The Seattle main operating room is shown in Fig. 5. The latter exchange has had more than it could keep up with in the way of increased business on account of the rapid growth of Seattle and the enormous number of calls per subscriber on business telephones, running sometimes as high as an average of 60 per day. This has led to the policy of taking nothing but measured service business customers after Jan. 1, 1901. The old flat rate was $6 per month for business telephones. The new rate is $5 per month for 100 calls or less, and 2 cents per call for all in excess of 100 calls.

Fig. 7 completes the set of Portland operating room views by showing the long-distance board. Exchange equipments and all

FIG. 6.—ADVERTISEMENTS.

technical electrical matters are in charge of F. W. Alston, electrician.

This company has never, in the past few years at least, acted on the theory of some companies enjoying a monopoly, and assumed that all the business possible would come without any solicitation on the company's part. A constant and vigorous effort is made to keep the convenience and importance of telephone service before the public. The public is being constantly reminded that there is a telephone company doing business in the town. What the independent

FIG. 8.—WINDOW OF PUBLIC OFFICE, SAN FRANCISCO.

movement is doing in the East to educate the public to the general use of the telephone the Pacific States company has done on the coast by its own push. The management has never lost faith in the future of the telephone, and has never believed that its present application is more than a small fraction of what is to be. Herein un-

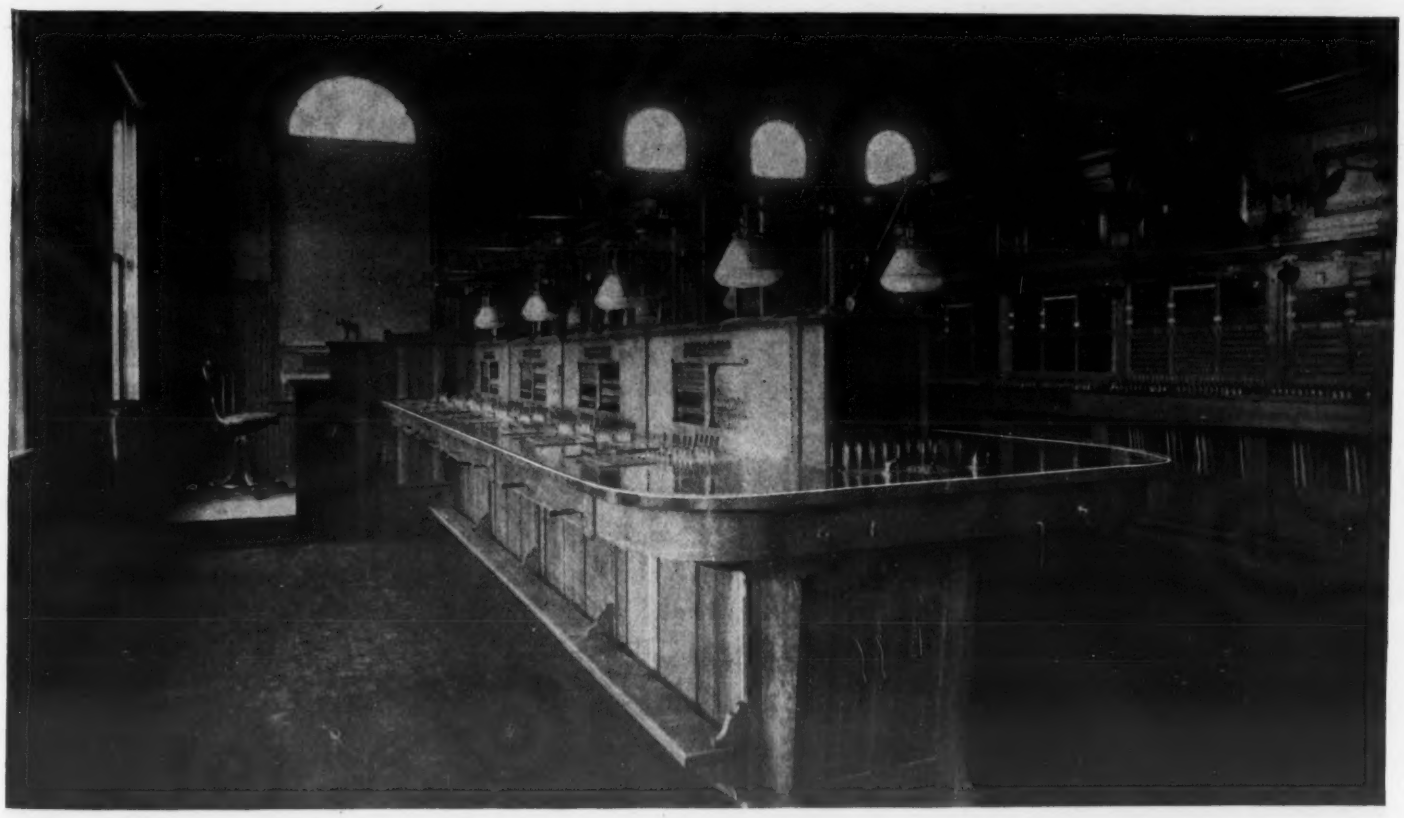


FIG. 7.—PORTLAND LONG-DISTANCE BOARD.

doubtedly lies much of the secret of the extensive use of the telephone on the Pacific Coast, and this also accounts for the small number of independent exchanges. Just how strong the independent movement will prove in the future on the Pacific Coast is hard to determine.

It is difficult to give an idea of the extensiveness and force of ad-

FIG. 9.—WINDOW OF WEST OFFICE, SAN FRANCISCO.

vertising methods at a distance, but some of the accompanying illustrations show the way the telephone is brought to the attention of the public. Fig. 6 shows a group of some of the catching advertisements used. Figs. 8 and 9 show two public office windows, which are fair examples of their class. The advertising value of such windows with the handsome lettering used is considerable. The telephone directory is liberally used as an advertising medium as well as the daily paper. The following paragraph appears on the front

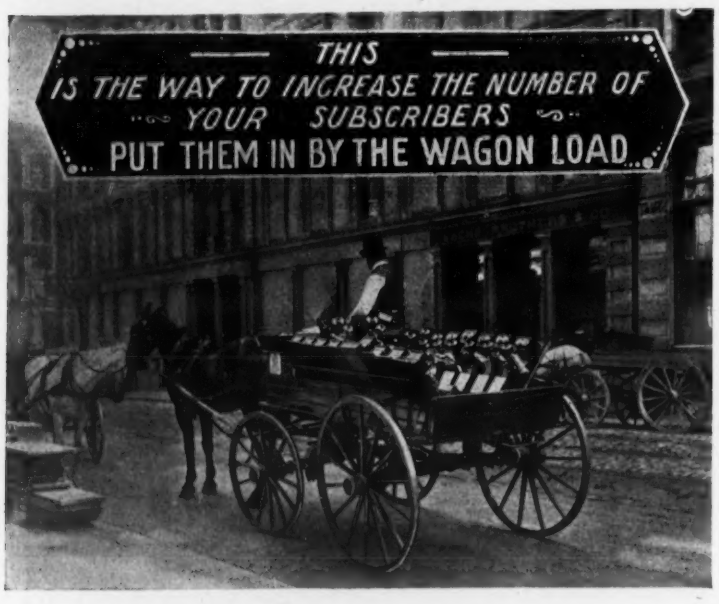


FIG. 10.—PRESIDENT SABIN'S ADVICE.

cover of the last telephone directory, and in numerous other places:

EXPANSION.

It is the purpose of the management to extend the use of the telephone to every town, no matter how small, throughout the Pacific States; and in all of the cities and towns, to put a telephone, at the most reasonable rates, within easy and immediate reach of every person whose income is sufficient to permit him to ride on street cars.

When a subscriber's line becomes so crowded with business that the line is frequently busy when called for, a memorandum is kept of the number of times a day this happens, and the next day the following card is received by the subscriber filled out with the proper name and number:

> SAN FRANCISCO.....
> *To*.....
> Telephone No.....
> Our operating department reports being compelled to say, "Line is busy, call again".....times during business hours yesterday.
> We have special rates (very low) to remedy this trouble and probable loss of business to you by subscribers (finding *your* doors practically closed) going elsewhere.
> Telephone or write the undersigned and an agent will be sent to explain the system. L. H. JACOBI,
> Telephone, Main 298. *Contract Agent.*

In closing this article, one cannot do better than to offer the advice President Sabin, with his characteristic humor, offers to other telephone officers in the photograph, Fig. 10.

The thanks of the writer are due to the officers of the Pacific States Telephone & Telegraph Company for the very courteous treatment and full information received at their hands when he was recently on the Pacific Coast, especially to President John I. Sabin, and also to E. J. Zimmer, assistant to the president, for information as to the company's business methods; to F. W. Alston, electrician, who has charge of all exchange equipment and apparatus, and to A. J. Steiss, engineer in charge of all construction, lines and buildings. It is proposed to close this series by some data on the company's line construction.

Power Development in British Columbia.

The Stave Lake Power Company has recently acquired a valuable franchise from the city of Vancouver, giving it the right for 50 years to do business as a power company within the corporate limits of the city of Vancouver. The water rights on Stave River were taken up some two years ago by J. B. Ferguson and George C. Hinton, of that city. They were met by some adverse claims, and the first summer was spent in a legal contest, which finally resulted in the rights going to Messrs. Ferguson & Hinton, who organized the Stave Lake Power Company with a capital of $1,000,000. They were required, under the Water Clauses Consolidation Act, to file their plans of operation with the Government, and to do a certain amount of work the first season, which has been done. Their next difficulty arose in obtaining the franchise to come into the city of Vancouver under favorable terms, as they were met at once by opposition from vested interests, which proved very strong, and it looked for a long time as if the company was not going to obtain the privileges which it sought. This difficulty has now been overcome, and it is expected that the company will soon start operations.

The power is situated 31½ miles from the city of Vancouver, and about 25 miles from the city of New Westminster. The engineer of the company reports that 17,000 horse-power can be developed at the Falls, and that this amount of power can be duplicated at another point lower down on the stream. There is at the present time about 20,000 horse-power in use by various industries at New Westminster and Vancouver and along the line of Burrard Inlet. It is hoped that about half of this power can be secured for the company.

Cable Connections with the Madeiras.

Consul Jones, of Funchal, states that the Eastern Telegraph Company has just finished laying a cable from Falmouth to St. Vincent, Cape Verde Islands. It passes through the office of the Western Telegraph Company, Limited, at Funchal, and is worked in connection with the Cape-St. Helena route. The latter company has landed four cables at Funchal—two at Lisbon and two to St. Vincent. One of the Lisbon cables is continued to Brazil and connects that country with Europe. The direct cable route from Funchal to the United States, adds the consul, is via Lisbon and the Azores. The tariff to New York is about 50 cents per word.

Frequency Converters.

BY A. S. MCALLISTER.

FOR the satisfactory operation of arc lamps a frequency higher than 40 p. p. s. is required, while when the frequency is much below this value incandescent lamps show a decided fluctuation in brilliancy. The output of transformers may be shown to vary as the three-eighth power of the frequency. These are among the causes for the fact that in the older lighting stations a frequency as high as 133 p. p. s. was quite common.

With later increase of magnitude and range of service, it was found that a lower frequency improved the operation of alternators in parallel, while the line regulation was also benefited by the change from the higher frequency. This led to the adoption of a periodicity of about 50 to 60 p. p. s. With the advent of the long-distance power transmission circuits, the advisability of the adoption of a still lower frequency became apparent, while the successful use of rotary converters for railway work practically necessitates a frequency as low as 25 cycles. This is the present standard frequency for such service.

The lowest frequency proposed up to the present date is 15 p. p. s. for use with gearless induction motors for traction purposes. The economy of its adoption is questionable from the standpoint of both the generators and the transformers. That the frequency of 25 cycles will remain for general power purposes seems quite probable.

When lighting is to be done from energy supply at 25 cycles, some means must be provided for altering the nature of the current before it can be applied to the lamps. A most satisfactory method of accomplishing this result is by means of alternating-current motors, of either the induction or synchronous type, driving lighting generators. Where only high-voltage alternating currents are available this method requires the use of step-down transformers, a motor and a generator, each carrying the full load. When the pressure at hand is sufficiently low, step-down transformers may be dispensed with, but a double equipment and double transformation of energy is still necessary, with consequent low efficiency and high cost of installation.

A recently developed method for changing the lower frequency to a value suitable for lighting purposes is by the use of "frequency converters," which constitute a special adaptation of induction motors as secondary circuit generators.

In the ordinary induction motor the frequency of the secondary current is not that of the supply, but it has a value represented by the product of the percentage slip of the secondary from synchronous speed and the frequency of the primary current. It is only when the slip is unity, or at standstill that the primary and secondary frequencies are equal. Under this condition the windings are in a true static transformation, and, with the secondary clamped to prevent relative motion, current at the primary frequency can be drawn from the secondary windings. Obviously, the air-gap renders the induction motor for such purposes much inferior to a static transformer, on account of magnetic leakage between the coils.

If, now, the secondary be given a motion relative to the primary there may continue to be drawn from the secondary current at a frequency determined by the slip from synchronous speed. If this slip be greater than unity—that is, if the motor be driven backwards—the frequency of the secondary current will be greater than that of the primary. By properly proportioning the rate of backward driving, the secondary current can be given a frequency of any desired value.

In order that the secondary frequency may bear a constant ratio to the primary, it is necessary that the relative slip from synchronism be constant, which condition can conveniently be obtained by driving the secondary with a synchronous motor operated from the same supply current as the primary.

Evidently the synchronous motor will demand power from the supply in addition to that demanded by the primary circuit of the frequency converter. The amount of this power is determined by the speed of the synchronous motor and the torque exerted by the frequency converter. When the slip of the converter is unity, the power demanded by the synchronous motor is zero; when, however, the slip is two—that is, when the frequency of the secondary is twice that of the primary—the power demanded by the synchronous motor is equal to that demanded by the primary of the converter. A further analysis will show that the power supplied by the frequency converter bears to the total output the ratio of the primary frequency to that of the secondary, the remaining power being supplied by the synchronous motor.

Since the total output appears at the secondary of the converter it behooves us to ascertain in what manner the power supplied by the synchronous motor enters the converter windings.

Let the ratio of primary to secondary turns be unity, and let us consider the secondary current in phase with the secondary e. m. f., and let it be counter-balanced by an equal current in the primary in phase with its e. m. f., then

I = primary current,
I = secondary current,
E = primary impressed e. m. f.,
SE = secondary generated e. m. f., where S = slip in per cent,
IE = primary power,
ISE = secondary electrical power.

In the ordinary induction motor, where S is less than unity, the secondary generated power (SIE) is dissipated in the copper of the secondary windings, while the remaining power received from the primary ($IE - SIE$) is available for mechanical work. When SE is equal to unity the secondary generated power (IE) is totally available as electrical energy, which may be lost in the resistance of the secondary windings or usefully applied to external work, while the mechanical power of the secondary is zero. When S is greater than unity the total secondary generated power (SIE) is available at the secondary terminals. Of this power (IE) is supplied by the primary, while the remainder is supplied by the synchronous motor.

We thus see that the effect of driving the secondary backwards is to increase the secondary pressure above that of the primary, and that the power for such increase is derived from the synchronous motor.

A moment's reflection will show that there is only partial double transformation of energy with a frequency converter, and that the sum of the capacities of the synchronous motor and the converter must just equal the output plus the inevitable losses in each machine. A numerical example will show this quite plainly. If we assume a lighting load of 60 kilowatts to be changed in frequency from 25 to 60 cycles, then the capacity of the frequency converter proper must be 25 kilowatts, and that of the synchronous motor 35 kilowatts, as shown above. It should be noted, however, that while the iron loss of the converter primary is the same as that of a 25-kw induction motor on 25 cycles, the iron loss of the secondary of the converter is that of a 60-cycle, 60-kw generator, and thus very materially greater than that of a 25-kw induction motor, which latter, in fact, is usually quite negligible.

By over-excitation the leading component of the current demanded by the synchronous motor may be adjusted to equal the lagging component due to the exciting current of the frequency converter, so that the external apparent power factor of the equipment may be kept quite high.

An Electric Typewriter.

BY B. C. WASHINGTON, JR.

THE application of electricity to operating a typewriter has converted it into a power machine, utilizing the operators merely in the capacity of a director, and practically relieving them from all physical work. The mechanical construction of the machine is extremely simple, and the trend of each operation is very easily followed by any one, whether familiar with machinery or not. Fig. 1 is a sectional view intended only to show the method of applying the electricity, and the manner in which it performs its work. The amount of current required to operate the machine is very small indeed, and is obtained in a variety of ways.

In Washington, the home of the company, where a large number of these machines are now in daily and constant use, current is, as a rule, taken from circuits of the city light and power company, by inserting a plug in a lamp socket, or by making a special connection, and leading the flexible twin cable to the binding posts at the rear of the machine. The electrical equipment of the machine is protected by inserting a quarter ampere fuse in the fuse block.

Another effective plan of securing power is by using a battery of six Harrison's No. 1 primary cells. Four cells are all that are required. The extra cells are a reserve to be connected up when the battery weakens. The portable battery box for the six cells has the

following inside dimensions, 10¼ by 6⅝ inches in depth. Two small storage battery cells also furnish ample current for operating the machine.

By referring to Fig. 1 it is seen that the depression of the front end of the key lifts the back end, and the little foot there pushes upward the push piece or latch, thus raising the horizontal arm of the bell crank lever, whose vertical arm by means of a link moves the

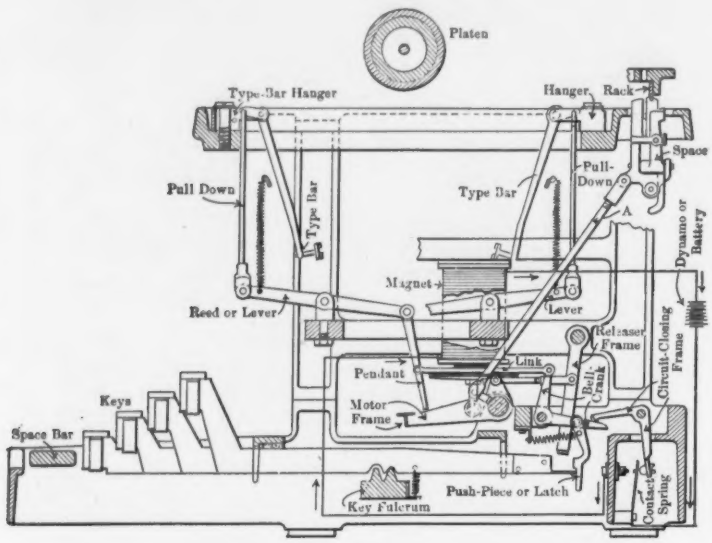


FIG. 1.—SECTIONAL VIEW OF ELECTRICAL TYPEWRITER.

pendant into the path of the motor frame. While this movement is taking place the horizontal arm of the bell crank lifts the horizontal arm of the circuit-closing frame, pushing forward its lower arm and pressing the platinum point in the contact spring against the contact point carried in an adjustable screw. The instant the circuit is closed, the armature of the electromagnet pulls up the motor

FIG. 2.—VIEW SHOWING MAGNET AND RHEOSTAT.

frame, and through the pendant, which has been moved forward into the path of the motor frame, lifts the inner end of the reed or lever, throwing down the outer end, which, through the pull-down wire, throws the type bar against the platen. Fig. 1 also shows a small adjustable link connecting the motor frame and the knockout or releaser frame, so that the latter, when the motor frame has raised the pendant the desired distance, knocks the push-piece or latch off the foot of the key depressed, and thus breaks the electric circuit. The breaking of the circuit allows the motor frame, push piece, bell crank, link, pendant, reed, or lever, pull-down wire, type bar and space mechanism all to return to their normal positions independently of the key, though it may still be held down by the finger of the operator. While it requires considerable time to describe these operations, they are all performed by the machine in an instant, and so very quickly that the motions of the parts cannot be followed by the eye.

When the circuit is automatically opened and the parts have returned to their normal position, another key may be depressed without waiting to release any other key which may be down. It is in this manner that the running legato touch is obtained in a type-bar machine. This has never been accomplished before. A glance at Fig. 1 shows that there is but one electromagnet for operating all the type bars in the machine—that there is but one motor frame—that there is but one contact frame, and but one place where the electric circuit is closed and opened. The power is transmitted practically through just one lever between the motor frame and the pull-down wire; that is, from the place where the power is applied (the motor frame) to the type bar, the path for the power is just as direct as in the very simplest and most direct non-electrical typewriter. In the non-electrical machines, the finger usually presses the finger piece on one end of a reed or lever, which pulls down the pull-down wire, and so throws the type bar against the platen. In this electrical typewriter the motor frame presses the reed or lever through the pendant and the other end of the reed draws the pull-down wire, which throws the type bar against the platen.

The ribbon mechanism (not shown in Fig. 1) is also impelled from the motor, and not by the finger or carriage mainspring. The power of the electromagnet is controlled by a small rheostat having six contacts The handle of the rheostat is back of and below the electromagnet, in easy reach of the operator. The power of the electromagnet is under ready control, and a copy of perfectly uniform distinctness is made, since every type bar strikes the paper with exactly the same force. These machines can be operated by direct or alternating current, by a storage or primary battery, and can be regulated to take current ranging in e. m. f. from 4 volts to 500 volts. Ordinarily a very weak current is used, but this is increased when carbon copies are being made. From 18 to 20 perfectly distinct carbon copies are made at one time, an accomplishment not yet attained by non-electrical typewriters. A touch of from two and a half to four or five ounces is quite sufficient to operate the keys, which are depressed about one-third as far as the keys of non-electrical typewriters.

Greater speed and better work are the results secured, without any wearying or enervating effects on the operator.

The arrangement of the spacing mechanism is such that the striking of the space bar simultaneously with the last letter of a word

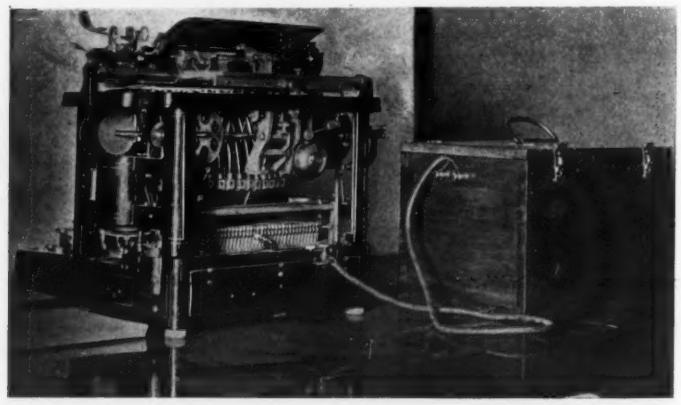


FIG. 3.—REAR VIEW, SHOWING ELECTRICAL CONNECTIONS.

makes the space. As words ordinarily average five letters, this arrangement makes a clear speed gain of 20 per cent. The importance of the electrically operated typewriter has been recognized by the Patent Office, and readers of the ELECTRICAL WORLD AND ENGINEER who attend the Pan-American Exposition at Buffalo will find this machine included by request in the Patent Office exhibit.

The offices and factory of the Cahill Electric Typewriter Company are at the corner of Eleventh and G Streets, Washington, D. C.

Bleaching at the Anode by Electro-Chemical Action.

BY WOOLSEY MCA. JOHNSON.

BLEACHING of coloring matter is caused by action of nascent oxygen on the organic substances. The result is that the coloring matter is oxidized to colorless products. This can be attained by the use of chlorine water, ozone, hydrogen peroxide, sodium oxychloride, bleaching powder with acid, etc. All these substances bleach because they liberate nascent oxygen. As a current of electricity liberates nascent oxygen at the anode it should be theoretically possible to bleach by the agency of electrolytic action at the anode.

With this end in view I performed the following experiments at the Jarvis laboratories of Trinity College, Hartford, Conn. A current was passed through a piece of paper written upon, soaked in an acidified solution of sodium chloride between two electrodes. The result was that wherever the current passed the ink was erased by the action of the nascent oxygen liberated by the current and by the secondary chemical action of the chlorine set free.

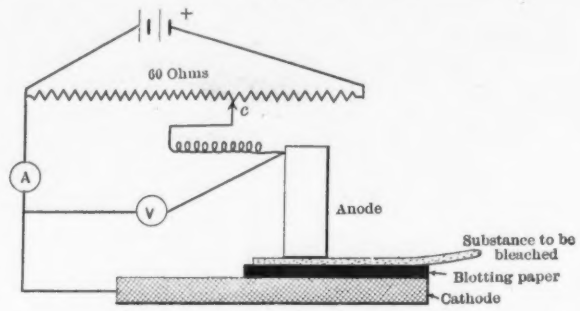


FIG. 1.—DIAGRAM OF CONNECTIONS.

The details of the process are as follows: Two Leclanché cells are closed through a 60-ohm circuit, enabling us to apply to the shunt circuit any potential by the variable contact *c*. In the shunt circuit are found a pair of electrodes separated by a piece of blotting paper. The electrodes can be made of any substances not attacked by the products of electrolysis. Carbon electrodes are well adapted for this purpose. The cathode was flat, and about 4 inches square. The anode can be of almost any dimensions, according to the size of the substance to be bleached.

If a small stain, it might be convenient to have the electrode of the size of the stain. The solution can be of various strengths, according to the refractoriness of the stain. I used a saturated solution of sodium chloride acidified with 1 per cent hydrochloric acid in most of my experiments. The voltage applied was 2 volts for rapid work, with a current density of 0.05 ampere per square centimeter. For fine, delicate work the voltage was about 0.2 volt above the "Zersetzungspunkt" of normal HCl $1.31 + 0.2 = 1.51$ volt. With this voltage the current is reduced to very small limits, and the bleaching is complete only at the end of 2 or 3 hours. The two independent variables are the resistance of the solution, and the voltage applied. The dependent variable is the current. The "Zersetzungspunkt," or critical decomposition voltage for a normal solution of hydrochloric

FIG. 2.—PARTIAL BLEACHING OF SIGNATURE.

acid, is 1.31 volts. This, however, is considerably lowered, because the stains act as depolarizing agents and prevent complete anodic polarization. This fact is very important, because it shows that a disproportionately large part of the current goes to stains or impurities to be bleached. The action of the impurities is reducing, and the e. m. f. of polarization is reduced at these points, consequently the lines of current flow converge to these points. The result is that the bleaching is extremely efficient because the current density is highest, where the current has the largest amount of work to do This asymmetrical efficiency is greatest when the current is very small. The behavior of the current in this case is exactly like the deposition of zinc and copper out of the same solution, and is very simple in explanation. In any electro-chemical system—that is, an electrode and electrolyte—there are several "polarization points" due to the several distinct chemical reactions that are possible. Each of these reactions has its own chemical "dissolution-pressure," which is measured by its voltage against a standard electrode. When the e. m. f. applied to the electro-chemical system just exceeds the lowest "polarization-point," the first reaction proceeds isothermally and reversibly. When, however, the e. m. f. exceeds the second polarization-point or the second "Zersetzungspunkt," to use the expressive German term, we have the reaction proceeding to a higher chemical potential or to a higher state of chemical separation. Some unpublished researches made by me as a pupil of Professor Nernst, of Gottingen, show this quite clearly.

As a result of this principle, it is seen that the current works very effectively, provided the e. m. f. is kept below the second point of polarization, 1.67 volts, which is the voltage of the OH ions. As a matter of fact, in this electro-chemical system which we have there are three "polarization-points," viz.:

1.08 volts for O ions.
1.31 volts for Cl ions.
1.67 volts for OH ions.
} for normal concentrations.

And three secondary "polarization-points" caused by the reducing action of the impurities on each of the above points. The tendency is to lower each of these three points by reduction. Probably the most important point of polarization is the 1.08 volts, as shown in the researches of H. Zehrlaut, Vol. 7, page 501, *Zeit. f. Electrochemie.*

Keeping these principles in mind, a little practice in manipulation of the electrode, which can be held in the hand, and observation of the voltmeter and ammeter readings enables one to do good work in erasing ink-stains, bleaching cloth, etc. The cut herewith was my name, which I partially erased to show the action of the bleacher to a friend. Here delicacy and fineness of action were sacrificed to speed. The voltage was 2 volts, the current 0.02 amperes, and the time only 2 minutes, instead of several hours.

Modern Telephone Engineering—II.

(Concluded.)

BY KEMPSTER B. MILLER.

AN interesting feature about such trunking systems is the means which the incoming trunk operator at the second office informs the calling subscriber and the regular operator that line called for is busy. When she finds on testing that a line is busy, she inserts the trunk line plug into the "busy back" jack, which jack has connected in its circuit a machine giving an interrupted current which gives a peculiar, familiar, and, to most subscribers, an extremely disagreeable sound. This sound is heard by both operator and subscriber at the first office, and the disconnection is made.

There is probably no method of determining the relative activity of any city at different times of the day or on different days, so well as by watching the telephone exchange in that city in operation. For keeping track of their business and being able to handle it to the greatest advantage, telephone companies usually make at frequent intervals what they term "peg counts." These show the total number of calls received and connections made during each of the 24 hours of the day. These results, if plotted in the form of a curve, in which the abscissæ represent time and the ordinates represent total number of calls per hour, show graphically and in a striking way the amount of telephone business being transacted at any given hour.

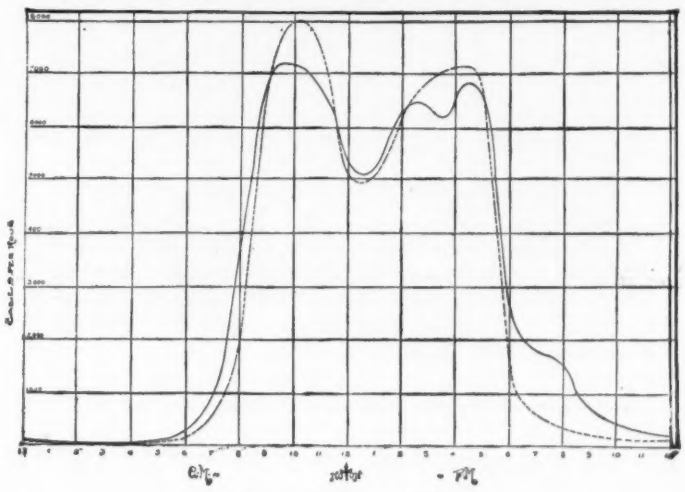


FIG. 7.—LOAD CURVE.

The curves (Fig. 7), show what I believe has never been shown before—that is, peg counts, taken the same day, of two opposition exchanges in the same city. These exchanges have about the same number of subscribers, not far from 6000. The dotted curve represents the telephone activity in the Bell exchange, while the solid curve represents that of the independent exchange. The rates of the Bell exchange are considerably higher than those of the independent, and from this fact we are enabled to draw several conclusions from the form of the two curves.

It will be noticed that from 12 at midnight until 6 o'clock both

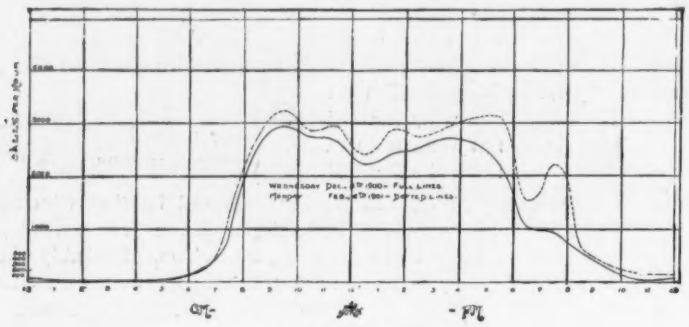


FIG. 8.—LOAD CURVE.

curves are very low, and gradually fall until 3 o'clock, after which they slowly rise until 6. This shows conclusively that the hour of 3 a. m. is that of least business activity, except, perhaps, in those lines, such as burglary and other allied industries which seldom require the use of telephone service. From the hour of 6 a. m. each of the curves rise rapidly, corresponding to the awakening of the city, reaching a maximum for the day in the neighborhood of 10 o'clock a. m. They then fall off to a minimum, corresponding to the lunch hour, between 12 and 1, and again rise to a second maximum between the hours of 4 and 5 in the afternoon, after which they rapidly fall during the evening hours. The fact that the independent exchange has cheaper telephones than the other will, perhaps, account for the fact that its subscribers begin work a little earlier in the morning, reach their maximum activity at a little earlier hour, take a little shorter time for lunch, go home a little later in the evening and work a little more all night, all of which facts are indicated by these two curves.

In Fig. 8 I show two curves representing telephonic activity of the

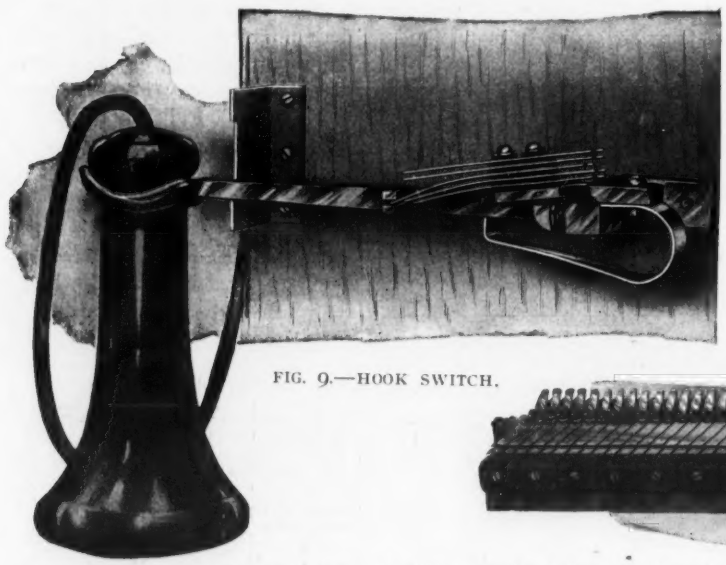


FIG. 9.—HOOK SWITCH.

same city on two different dates. It will be noticed that the dotted curve, which represents a Monday, shows a greater number of calls than the solid curve, which was taken on a Wednesday. It is usually true that Monday is about the busiest day in the week in telephonic exchanges. It would be interesting to trace the significance of the different humps or characteristics of these curves, but it will be noticed that whatever hump is on one is present, or at least suggested on the other. The pronounced hump on the dotted curve at the extreme right is undoubtedly due to the theater business, between 7 and 8 in the evening. Probably the reason why this was more pronounced on one curve than on the other was that there was a special attraction or special set of attractions, in the entertainment line, on the particular day on which the curve was taken. Such curves as these have been said by some one to represent the pulse of a city, and I think that the longer one thinks about it, the more apt this term appears. Every city has a heart in its telephone exchange, and this heart is throbbing with as great a regularity as that of any living creature.

Mr. Miller during his lecture illustrated by means of lantern slides many views of switchboards and telephonic apparatus, some of which are reproduced herewith. In Fig. 9 is shown a subscriber's

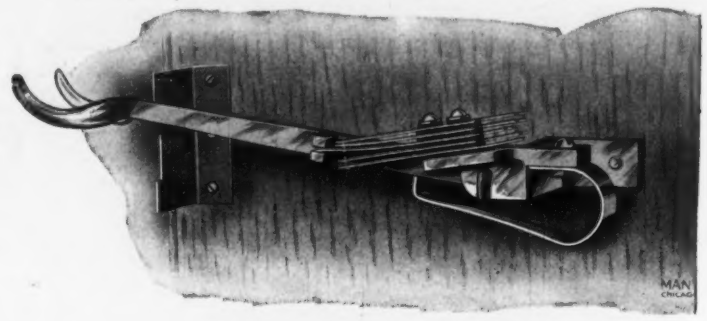


FIG. 10.—HOOK SWITCH.

automatic switch-hook with the receiver upon it, and in Fig. 10 the same hook with the receiver removed. It will be seen that the long lever serves to bend the central spring into engagement with the lower or upper set of springs according to whether the telephone is in use or not. This accomplishes the changes of circuit by which the operator is automatically called and by which she is later given the

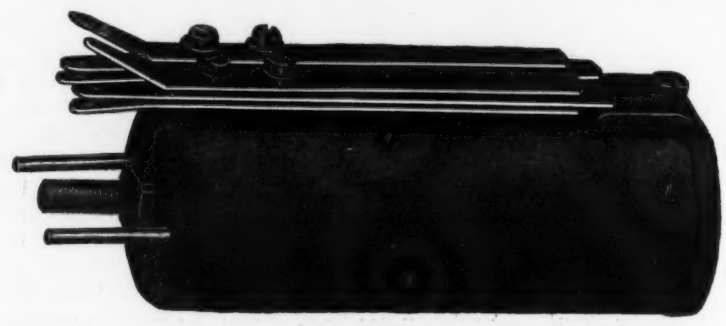


FIG. 11.—SINGLE CUT-OFF RELAY.

signal to disconnect, which changes are made, of course, entirely without the volition or knowledge of the subscriber.

Fig. 12 shows a strip of line relays similar to the ones used in the Pittsburg exchange. These relays are mounted 20 per strip, as shown.

A single line cut-off relay is illustrated in Fig. 11. The magnet of

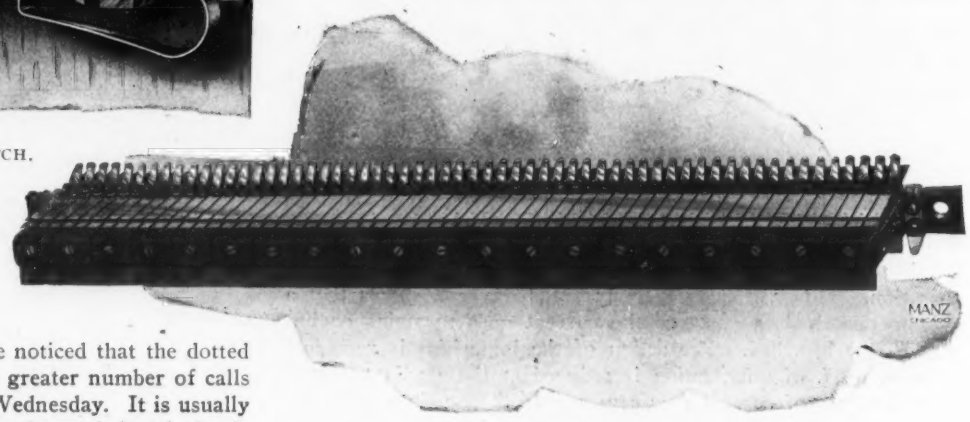


FIG. 12.—STRIP OF LINE RELAYS.

this is enclosed in an iron shell which forms a portion of the magnetic circuit. The armature of this relay, when attracted, causes the two long springs to break contact with the lower springs, and to make contact with the two upper springs. All contacts in the best relays of this description are made of platinum. These relays are about 1¼ inches in diameter, and the shells are of soft iron about ⅛ inch thick.

In the latest Kellogg exchanges the line and cut-off relays are mounted side by side on the same strip. Fig. 13 shows such a strip which contains 20 such relays, the line relays being the smaller of the two. This strip represents a unit of 20 lines, which unit is carried

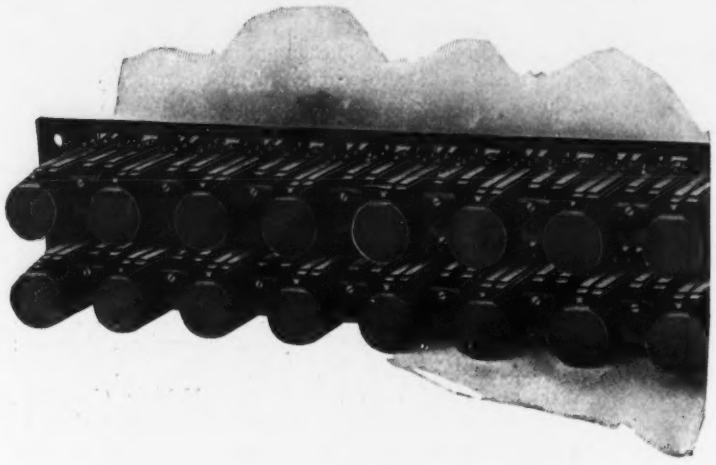


FIG. 13.—STRIP OF LINE AND CUT-OFF RELAYS—REAR VIEW.

throughout the entire scheme of wiring in the central office. Fig. 14 shows the opposite side of this relay strip, showing the connecting wires from the various terminals. These terminals pass through walls in the iron mounting strip and are readily accessible for soldering in the wires. In mounting the line and the cut-off relay in such close proximity, many of the wires which would otherwise have to

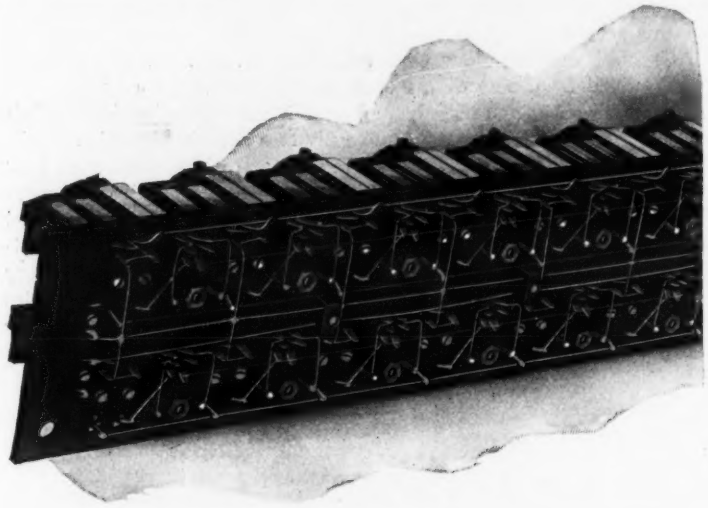


FIG. 14.—STRIP OF LINE AND CUT-OFF RELAYS—FRONT VIEW.

be formed up in cables are reduced to the short, stiff bare wires clearly shown in this picture.

Coming now to the line signals themselves in this picture is shown a strip of drops (Fig. 15), these being mounted on ½-inch centers so

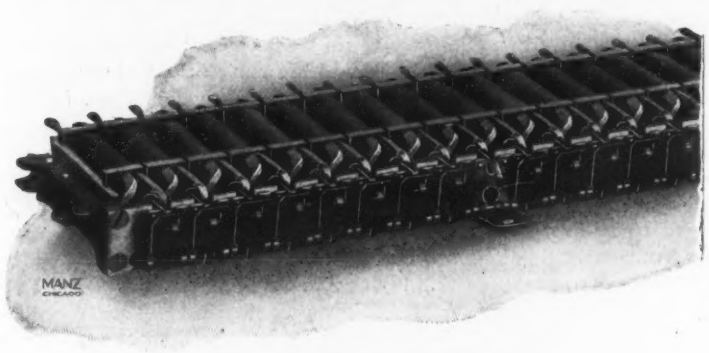


FIG. 15.—SIRIP OF DROPS.

as to correspond to the spacing of the jacks. These were used before the adoption of the line lamp signals by the Kellogg Company, a strip of which signals is shown in Fig. 16. This strip is formed from a single piece of hard rubber about 10 inches long and ½ inch thick.

The lamps, one of which is shown in the front of the view, are so arranged as to slide into their sockets between the jack springs in such manner as to make the proper circuit connections. In front o each lamp is a little lens, usually of opalescent glass, this lens being carried in a spun brass cap. The advantages of the line lamp signal over the old form of mechanical signal is obvious, the principal ones being the absolute freedom from complexity, cheapness, and the fact that they may be removed instantly if found defective and replaced by good ones. A defective line lamp may be taken out and another one substituted in less than one-half minute. Another beauty

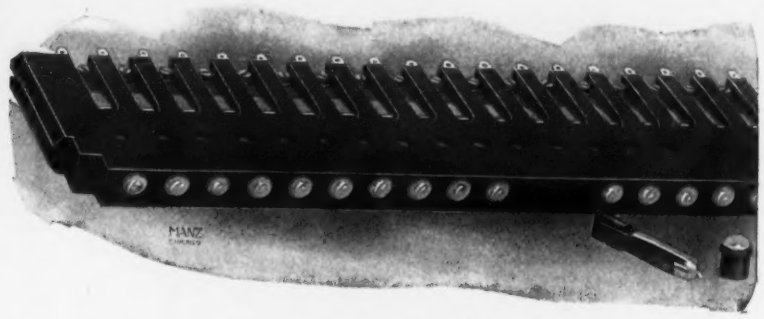


FIG. 16.—STRIP OF LAMPS.

of the line lamp is that when it is out of order it may be thrown away, which is much easier than repairing a mechanical drop. These lamps usually operate at 20 or 24 volts, take about ¼ ampere, and give approximately 1/3 candle-power. The calculated life of these lamps, with their present degree of perfection and with the average rate of use, is about 30 years, but, of course, this figure remains to be verified by actual service, for unfortunately the telephone business is not yet old enough to prove the statement.

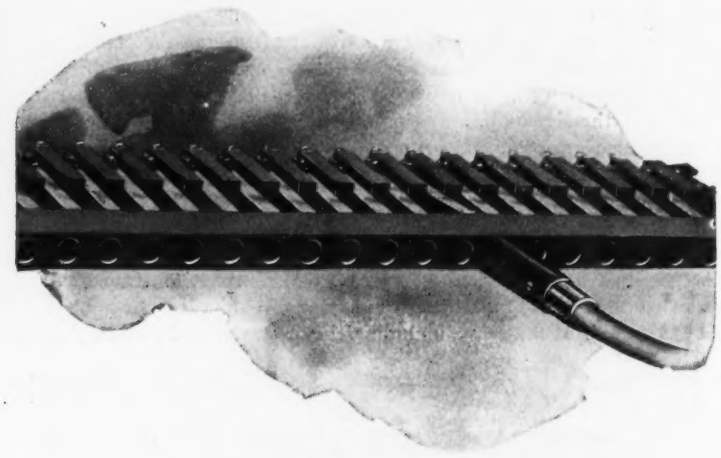


FIG. 17.—STRIP OF JACKS.

In Fig. 17 is represented by all odds the most important piece of apparatus in a telephone exchange—the spring jack. This is a strip of the two-point jack already referred to, and it will be seen that they are mounted 20 to a strip on spaces corresponding to those of the

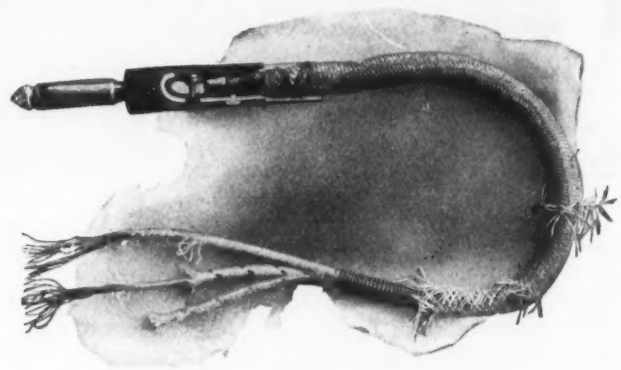


FIG. 18.—SECTION OF CORD AND PLUG.

lamp jack. The same jack is used for both answering and multiple. This strip is built up of hard rubber, brass and German silver, the front being a solid piece of hard rubber, slightly over 10 inches long, and drilled for receiving the sleeve contacts. The rear of the strip

is a piece of hard rubber milled to receive the line springs and the rearwardly projecting lugs from the sleeve contacts. This rear strip is reinforced by a heavy brass strip, into which the screws holding the line springs are threaded. In this particular strip the jacks are one ½-inch centers, the strip being 7/16 inch high. The spacing with this same construction is readily reduced to ⅜ inch. Where a smaller spacing than this is required, as in a board of extreme size, a somewhat different construction would be used.

Fig. 18. shows a cord and plug, the plug being cut away to expose the method of attaching the cord, the cord having its various layers

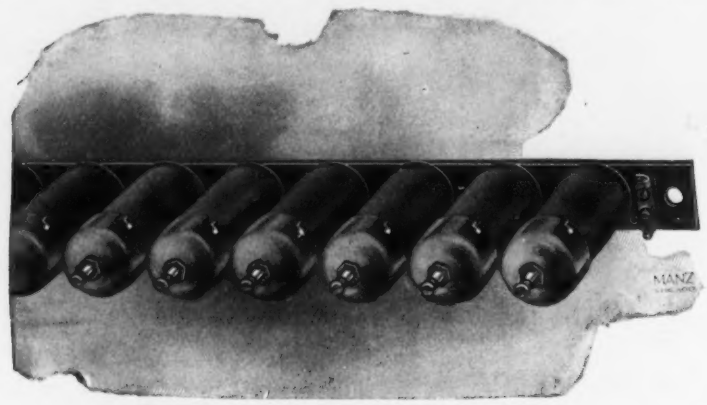


FIG. 18.—STRIP OF SUPERVISORY RELAYS.

removed to better show its construction. This plug has two contact points instead of three, as described in connection with Western Electric or Bell system. It will be noticed that the two strands of the cord are composed of twisted tinsel, over which a wrapping of floss silk and a braid of cotton are placed. Thus insulated, the two conductors are bound together by a wrapping of cotton, after which they are enclosed in a spiral of brass wire for protection. Over the spiral of wire are placed two layers of linen braiding throughout the entire length of the cord, and for about 10 inches back of the plug a third reinforcing layer is put on. These cords vary in length, according to the size of the multiple board, this length being anywhere from 36 inches up to nearly 100 inches.

The next view (Fig. 18) shows a strip of supervisory relays, these relays being the ones used in connection with the cord circuit for controlling the supervisory lamps. These are iron clad, being made in the same shell as is used for the cut-off relay. The armature, a disk of iron about 1¼ inches in diameter, is suspended in front of the poles of the electromagnet by a thin leaf spring. The working parts of the relay, including the armature and contact points,

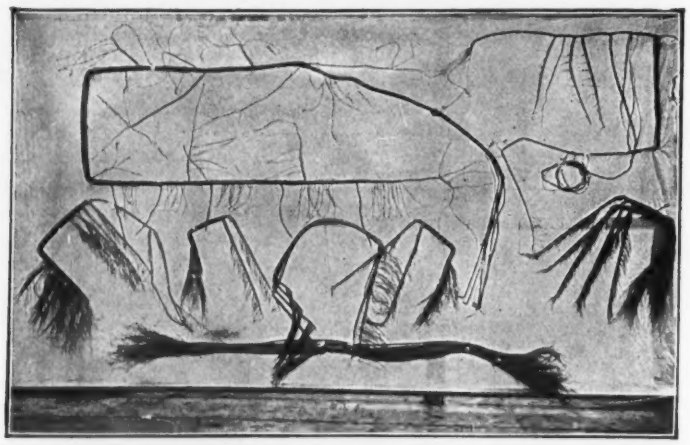


FIG. 19.—CABLES FANNED OUT.

are enclosed in a brass cap, which cap locks on the shell with a bayonet joint.

The final cut (19) shows a few of the cables used in switchboard work, as they are formed up in the factory. Some of the cables are made from standard 21 and 41-pair cables in long lengths with their ends formed and laced to fit the particular portion of the switchboard for which they are required. Some of the other cables are formed by hand, exactly as shown, directly from the insulated wire, which is usually twisted in pairs. These cables, as you will see, remind one more of diagrams of nervous systems, sometimes seen in medical books, than anything else I can think of.

Central Stations and Automobiles.

The interest which local electric light companies are taking in the erection of charging stations in the large cities in the suburbs and even in the more remote localities connecting points popular for automobile touring is extending the radius of action for electric vehicles to many places which a couple of months ago it was impossible for this type of automobile to reach. In an electric vehicle one can now go from New York to Philadelphia, from Philadelphia to Atlantic City, from New York to Morristown, N. J., from New York to the popular resorts along the Jersey coasts as far as Spring Lake and to a score of other points of interest about New York. Charging stations are now being installed in the following places in New Jersey, near this city, where vehicles can be charged at a rate amounting to less than 1 cent per mile for power:

Newark, 27 Mechanic Street; Elizabeth, livery stable of John Keron & Son, Morris Avenue; Morristown, 39 Washington Street; Orange, 17 Railroad Place; Jersey City, 544 Communipaw Avenue; Hoboken, Bloomfield and Fourteenth Streets.

In a recent communication to the Electric Vehicle Company, W. H. Johnson, of the Philadelphia Electric Company, writes as follows: "The following automobile charging stations are being established: Station of the Germantown Electric Light Company, Aramat and Cumberland Streets, Germantown; Germantown Cricket Club, Germantown; Philadelphia Country Club, Chestnut Hill; Philadelphia Country Club, West Philadelphia. Others will be established from time to time as the sale of electric automobiles progresses, so that there will be no trouble whatever in getting automobiles charged in Philadelphia or its vicinity.'

This same company, which is interested in the Philadelphia charging stations, has recently purchased a Columbia runabout for the use of the superintendent for looking after the details of his work. Of this service Mr. Johnson writes as follows:

"I would state that our electrical engineer, Mr. W. C. L. Eglin, was enabled by means of his electric runabout to go over two circuits in the suburbs and only took two hours from the time he left the office until his return. It took fully two days by the other methods. You see at once the time saving factor to important men. Our intention is also to place this vehicle in the hands of all our superintendents and electrical people, so that they will become accustomed to the operation and handling of vehicles and be prepared intelligently to take care of this business when the boom hits us. Every electric lighting station in the country should be buying vehicles for just this purpose, as sooner or later they will be called upon by some disabled fellow for assistance, and should be in a position to handle the matter intelligently."

Police Telegraph Operators.

Mr. George McAneny, secretary of the Civil Service Reform Association, has sent a letter to Governor Odell, of New York, on behalf of that organization, asking him to withhold his signature from the bill relative to the status of telegraph operators in the Police Department of the city of New York. The letter says that under the existing law the police telegraph operators, 14 in number, have a permanent tenure in common with the members of the uniformed force, and are paid at the rate of $1,850 per annum. The bill proposes to add to section 276 of the Greater New York charter the words "the telegraph operators to rank as sergeants of police." The letter adds: "The effect of this would be, apparently, to incerase the salaries of the operators to $2,000 annually—the salary fixed for the rank of sergeant—and to give to them all other rights of sergeants, including the right to compete for promotion to captain. In the latter respect the bill clearly contravenes the purpose of the Civil Service law, for the reason that it would permit persons who have not been trained for police work—and who have not passed the physical and other examinations required to qualify them for the lower police grades—to compete for this high rank. While the number of cases in which it might be attempted to promote members of the telegraph force to captaincies might, for a while, be small, there can be no doubt that an opportunity would be offered for serious abuse in the future, for, whenever a police commissioner chose to circumvent the law, to get in men of his own choice as captains, who are not qualified physically or by police training, he might have them, after relatively brief training, qualify as telegraph operators, and subsequently advance them to position of command.

Heating of Electrical Machinery Under Two Regularly Alternating Conditions of Load.

BY EDWIN RUST DOUGLAS.

WITH the multiplying applications of electric power, the problem of proper rating for an electric machine under regularly varying load becomes of much importance, for it will frequently happen that full output may be demanded for a brief time, while a considerable period of light load follows. It is well understood that, in these conditions, a smaller machine may be used than would be necessary if the heavy load were to be borne a larger part of the time, but the estimation of a machine's capacity under such circumstances is usually a matter of guesswork based on the memory of previous experiences.

The purpose of this article is to show that, from a knowledge of certain constants of a machine, its performance under any unusual conditions of load may be predicted with accuracy, and to explain the determination of those constants.

At the close of the mathematical analysis the formulæ derived will be collected for convenient reference, with sufficient explanation to make them independently intelligible.

While these formulæ, in their present shape, with their derivation, are here published for the first time, they were originally worked out, in slightly different form, for the use of the Crocker-Wheeler Company, and the substance of the latter conclusions was issued by them as a typewritten suppliment to their Bulletin No. 8. The confirmatory experiments referred to in this article were conducted in their laboratory.

Suppose the machine to alternate regularly between *two* conditions of speed, load, etc.,

Let s = time, considered as a variable,

s_1 = length of time, in minutes, through which each recurrence of the first condition endures.

s_2 = length of time through which each recurrence of the second condition endures.

t = temperature of the machine at any time, considered as a variable.

t_0 = temperature of the surrounding air or other cooling medium.

t_l = limiting temperature reached by the machine for a continuous run under the first condition.

t_l^1 = limiting temperature for a continuous run under the second condition.

c = specific heat of the machine.

q = heat generated per minute in the machine under the first condition.

q^1 = heat generated per minute under the second condition.

$\alpha (t - t_0)$ = loss of heat per minute under the first condition, proportional to the elevation of temperature above the surrounding air.

$\beta (t - t_0)$ = loss of heat per minute under the second condition.

Of course, either condition may be the one of greater load, etc., or one condition may be of no load, or even of absolute rest. In the latter case q^1 will be considered as becoming 0, and this is the case most likely to be met in practice, but the general proposition will be considered first.

Under the first condition the temperature rises at the rate

$$\frac{q - a\,(t - t_0)}{c} \text{ degs. per minute.}$$

Now, $q = a\,(t_l - t_0)$. Therefore, the rate of rise becomes

$$\frac{d\,t}{d\,s} = \frac{a}{c}\,(t_l - t)$$

Integrating,

$$s = \frac{c}{a}\int_{t_0}^{t} \frac{d\,t}{t_l - t} = -\frac{c}{a} \cdot \text{hyp log } \frac{t_l - t}{t_l - t_0}$$

Whence

$$t_l - t = (t_l - t_0) \cdot \varepsilon^{-s\frac{a}{c}} \qquad (1)$$

Now, at the end of the first condition in the first cycle

$$s = s_1 \text{ and let } t = t_1$$

Put

$$A = \varepsilon^{s_1 \frac{a}{c}} \qquad (2)$$

Then at that time the temperature is

$$t_1 = t_l - (t_l - t_0)\,\frac{1}{A}$$

At the time $s = s_1$ the second condition ensues and the rate of rise of temperature becomes

$$\frac{d\,t}{d\,s} = \frac{\beta}{c}\,(t_l^1 - t)$$

Integrating,

$$s - s_1 = \frac{c}{\beta}\int_{t_1}^{t} \frac{d\,t}{t_l^1 - t} = -\frac{c}{\beta} \cdot \text{hyp log } \frac{t_l^1 - t}{t_l^1 - t_1} \qquad (3)$$

$$t_l^1 - t = (t_l^1 - t_1) \cdot \varepsilon^{-(s - s_1)\frac{\beta}{c}}$$

Now, at the end of the first cycle $s = s_1 + s_2$ and let $t = t_1^1$

Put

$$B = \varepsilon^{s_2 \frac{\beta}{c}} \qquad (4)$$

Then

$$t_1^1 = t_l^1 - (t_l^1 - t_1)\,\frac{1}{B}$$

Or, substituting the value of t_1,

$$t_1^1 = t_l^1 + (t_l - t_l^1)\,\frac{1}{B} - (t_l - t_0)\,\frac{1}{A\,B}$$

When $s = s_1 + s_2$ the first condition re-ensues. As before,

$$s - (s_1 + s_2) = -\frac{c}{a} \cdot \text{hyp log } \frac{t_l - t}{t_l - t_1^1} \qquad (5)$$

When $s = 2s_1 + s_2$ let $t = t_2$

$$t_2 = t_l - (t_l - t_1^1)\,\frac{1}{A}$$

Substituting the value of t_1^1

$$t_2 = t_l - (t_l - t_l^1)\left(\frac{1}{A} - \frac{1}{A\,B}\right) - (t_l - t_0)\,\frac{1}{A^2\,B}$$

When $s = 2s_1 + s_2$ the second condition re-ensues. As before,

$$s - (2\,s_1 + s_2) = -\frac{c}{\beta} \cdot \text{hyp log } \frac{t_l^1 - t}{t_l^1 - t_2}$$

At the end of the second cycle $s = 2\,(s_1 + s_2)$ and let $t = t_2^1$

$$t_2^1 = t_l^1 - (t_l^1 - t_2)\,\frac{1}{B}$$

Substituting the value of t_2

$$t_2^1 = t_l^1 + (t_l - t_l^1)\left(\frac{1}{B} - \frac{1}{A\,B} + \frac{1}{A\,B^2}\right) - (t_l - t_0)\,\frac{1}{A^2\,B^2}$$

It will be unnecessary to carry the formation of values of t and t_1 farther, as the law of the series becomes apparent. The general terms evidently are

$$t_n = t_l - (t_l - t_l^1)\left(\frac{1}{A} - \frac{1}{A\,B} + \frac{1}{A^2 B} - \frac{1}{A^2\,B^2} + \cdots\right.$$

$$\left. \cdots + \frac{1}{A^{n-1}\,B^{n-2}} - \frac{1}{A^{n-1}\,B^{n-1}}\right) - (t_l - t_0)\,\frac{1}{A^n\,B^{n-1}} \qquad (6)$$

and

$$t_n^1 = t_l^1 + (t_l - t_l^1)\left(\frac{1}{B} - \frac{1}{A\,B} + \frac{1}{A\,B^2} - \frac{1}{A^2\,B^2} + \cdots\right.$$

$$\left. - \frac{1}{A^{n-1}\,B^{n-1}} + \frac{1}{A^{n-1}\,B^{n}}\right) - (t_l - t_0)\,\frac{1}{A^n\,B^n} \qquad (7)$$

The former is the temperature attained at the end of the first condition of the nth cycle. The latter is the temperature at the end of the nth cycle.

These series may be summed. For the former,

$$\frac{1}{A} - \frac{1}{A\,B} + \frac{1}{A^2 B} - \frac{1}{A^2 B^2} + \cdots + \frac{1}{A^{n-1}\,B^{n-2}} - \frac{1}{A^{n-1}\,B^{n-1}}$$

$$= (B - 1)\left(\frac{1}{A\,B} + \frac{1}{A^2 B^2} + \frac{1}{A^3 B^3} - \cdots + \frac{1}{A^{n-1}\,B^{n-1}}\right)$$

$$t_n = t_l - (t_l - t_l^1)\,(B-1)\sum_{j=1}^{j=n} \frac{1}{A^j B^j} - (t_l - t_0)\,\frac{1}{A^n B^{n-1}} \quad (8)$$

Now let n increase indefinitely

$$\lim_{n=\infty} \sum_{1}^{n} \frac{1}{A^j B^j} = \frac{1}{A B - 1}$$

and

$\lim_{n=\infty} t_n = t_m$, the maximum value t_n can reach. Also

$$\lim_{n=\infty} \frac{1}{A^n B^{n-1}} = \lim_{n=\infty} \left(-n\, s_1 \frac{a}{c} - (n-1)\, s_2 \frac{\beta}{c} \right) = 0$$

Therefore

$$t_m = t_l - (t_l - t_l^1)\,\frac{B-1}{A B - 1} \quad (9)$$

In a similar manner

$$t_n^1 = t_l^1 + (t_l - t_l^1)\,(A-1)\sum_{1}^{n} \frac{1}{A^j B^j} - (t_l^1 - t_0)\,\frac{1}{A^n B^n} \quad (10)$$

$$t_m^1 = t_l^1 + (t_l - t_l^1)\,\frac{A-1}{A B - 1} \quad (11)$$

The series in equations (8) and (10) converge for all values of $A B$ greater than 1, and since $A B = \varepsilon^{s_1 \frac{a}{c} + s_2 \frac{\beta}{c}}$ it must always be greater than 1.

If, however, it be desired to shorten the periodic time $(s_1 + s_2)$, the ratio $\frac{s_1}{s_2}$ remaining constant, and n increasing so that the total time elapsed, $n\,(s_1 + s_2)$ is unchanged, there enters a question of double limits and convergence. The steps in the analytical consideration of this question will be omitted here, and merely the result given which is expressed by the equations

$$t_i = \frac{t_l \,\frac{k}{100-k} \cdot \frac{a}{\beta} + t_l^1}{\frac{k}{100-k} \cdot \frac{a}{\beta} + 1} \quad (12)$$

and $$(t_i - t_s) = (t_i - t_0)\,\varepsilon^{-\gamma n} \quad (13)$$

where

t_i = limiting temperature after a long run under these conditions.

t_s = temperature at s minutes from the start.

k = per cent of time during which the first condition lasts, or

$$\frac{k}{100} = \frac{s_1}{s_1 + s_2}$$

and where $$\gamma n = \frac{1}{100}\left[k\,\frac{a}{c} + (100-k)\,\frac{\beta}{c}\right] s \quad (14)$$

This expression is of exactly the same form as (1), showing what might also have been apprehended, that the curve approached when the alternations of load become rapid is of the same class as that for continuous load of one character.

We now have, in equations, (8), (9), (10), (11), (12) and (13), the means of finding the temperatures reached under any disposition of two regularly alternating conditions of load after any number of alternations.

In these equations there are involved the quantities A, B, a, β, γ, and c, with t_0, t_l, and t_l^1.

The latter three are easily found by direct experiment. To determine the former proceed as follows:

If starting with the machine at any temperature t_a and running a time s_a under the first condition, the temperature rises to t_a^1, then by (5)

$$s_a = -\frac{c}{a} \cdot \text{hyp log}\, \frac{t_l - t_a^1}{t_l - t_a}$$

$$\frac{a}{c} = \frac{1}{s_a} \cdot \text{hyp log}\, \frac{t_l - t_a}{t_l - t_a^1} \quad (15)$$

Also if starting with the machine at any temperature t_b and running a time s_b under the second condition of load, the temperature rises (or falls) to t_b^1, then by (3)

$$s_b = -\frac{c}{\beta} \cdot \text{hyp log}\, \frac{t_l^1 - t_b^1}{t_l^1 - t_b}$$

$$\frac{\beta}{c} = \frac{1}{s_b} \cdot \text{hyp log}\, \frac{t_l^1 - t_b}{t_l^1 - t_b^1} \quad (16)$$

A, B, and γn being found by (2), (4) and (14), the values of t_n, t_m, t_n^1, t_m^1, t_s and t_i are completely defined.

There is also a shorter method of finding the expression $\frac{a}{\beta}$ From (15) and (16) we have

$$\frac{a}{\beta} = \frac{s_b}{s_a} \cdot \frac{\text{hyp log}\, \frac{t_l - t_a}{t_l - t_a^1}}{\text{hyp log}\, \frac{t_l^1 - t_b}{t_l^1 - t_b^1}}$$

If then, we make $t_a = t_l^1$, $t_b = t_l$, and $t_b^1 - t_l^1 = t_l - t_a^1$, which may readily be done in experiment, and double the subscripts to distinguish these special values from those in the previous formulæ, the logarithms become equal and

$$\frac{a}{\beta} = \frac{s_{bb}}{s_{aa}} \quad (17)$$

DIRECTIONS FOR TESTS AND COMPUTATION.

By formulæ (1) to (5) it is evident that if t_l be the limiting temperature reached by a machine after a long run under any given condition of load, the curve of changing temperature during the run is an exponential one asymptotic to the value t_l. In Fig. 1 the full lines

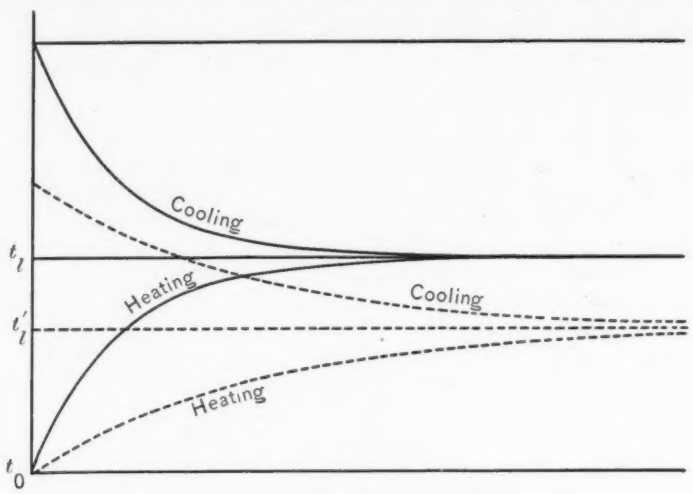


FIG. 1.—HEATING AND COOLING CURVES.

show the forms of such curves, starting at temperatures below and above t_l. The curve for cooling is of the same form as the curve for heating under that condition of load and asymptotic to the same value of temperature, but inverted.

For a different condition of load t_l would be different, and the curves might be very different in proportions, as indicated by the dotted lines in Fig. 1.

Results of experiments made to determine the laws of heating and of cooling of machines agree very well with these theoretical curves, so that we may apply the theory to the investigation of more complex cases.

A machine run alternately under two or more conditions of load will heat or cool irregularly, its heating curve being made of fragments of the several complete curves belonging to those conditions.

This is shown in Fig. 2, where the performance of a machine under two conditions of load is exhibited.

Here t_l and t_l^1 are the limiting temperatures under the first and second conditions, respectively. Curve 1 is the heating curve under the first condition, and curves 2, 2 are the heating and cooling curves for the second condition. The broken curve A is for 30 minutes under condition 1 and 15 minutes under condition 2, alternating regularly. Curve B is for 15 minutes under condition 1 alternating with 30 minutes under condition 2, leading to materially lower temperatures than with curve A. We will call o a b the first cycle, b c d the second cycle, and so on. Then o a is the first condition of the first cycle, e f the second condition of the third cycle, etc.

This will explain the nomenclature of the article.

In any cycle the machine rises or falls between two limiting temperatures, t_n and $t_n{}^1$, which vary from one cycle to another. After a great number of cycles the machine rises and falls continuously between two constant limiting temperatures, t_m and $t_m{}^1$.

If the alternations be rapid, the curve approaches to smoothness, as shown in Fig. 3. Here conditions 1 and 2 endure only 5 and 10

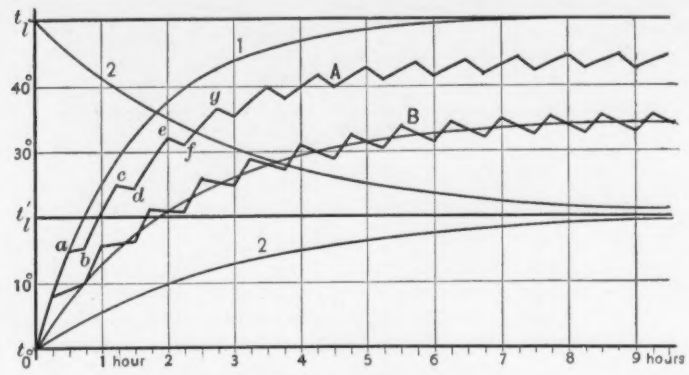


FIG. 2.—COMPOSITE HEATING CURVES.

minutes, respectively, or one-third of the values for curve B (Fig. 2). A comparison of the two is instructive.

The amount of rise and fall being so small, it may be sufficient to determine a mean curve running between the limiting temperatures. This mean curve is of the same exponential character as those for continuous heating or cooling, but is asymptotic to a limiting temperature between those of its component curves.

The application of these formulæ is simple. It is quite feasible to determine, by experiment on any machine, a set of constants for that machine, one for each of a number of conditions of load, as for absolute rest, running free, quarter, half, full load, etc., from which, at any future time, its performance under any regularly recurring combination of those conditions may be determined.

Thus, to determine the constant for any condition:

First.—Starting with the machine at any temperature t_a —which may preferably equal the room temperature, but must not be very near to t_l as found by the next test—run it under that condition of load for any convenient length of time s_a, as 30 minutes and immediately note its temperature $t_a{}^1$.

Second.—Run the machine continuously under that condition of

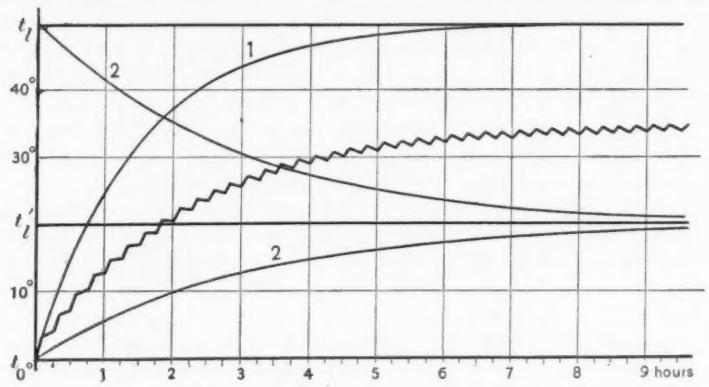


FIG. 3.—COMPOSITE HEATING CURVES.

load for several hours, or until stationary temperature is reached. Note this limiting temperature t_l.

The temperature of the surrounding air must remain practically constant through these two tests. Find

$$\mathrm{a} = \frac{1}{s_a} \text{ com log } \frac{t_l - t_a}{t_l - t_a{}^1} \tag{18}$$

Note.—The a *of this formula equals* $\frac{a}{c}$ *of formula* (15) *multiplied by* 0.4343, *the modulus of the common system of logarithms.*

In like manner, for other conditions of load, we may find

$$\mathrm{b} = \frac{1}{s_b} \text{ com log } \frac{t_l{}^1 - t_b}{t_l{}^1 - t_b{}^1} \tag{19}$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

$$\mathrm{x} = \frac{1}{s_x} \text{ com log } \frac{t_l{}^{(h)} - t_x}{t_l{}^{(h)} - t_x{}^1}$$

where $t_l{}^{(h)}$ represents the limiting temperature for continuous run under that condition of load.

These constants, a, b, . . . x, are properties of the machine.

To apply them, first, to the CASE OF SLOW ALTERNATION between two conditions of load, as with a period of five minutes or more, suppose the machine to run alternately a time s_1 minutes under the first condition and s_2 under the second condition. Starting at an air temperature t_0, required the temperature the machine will reach after any given number of alternations, and also its limiting temperatures after a long run.

$$\text{Find } A \text{ such that com log } A = \mathrm{a} \,.\, s_1 \tag{20}$$

$$\text{and } B \text{ such that com log } B = \mathrm{b} \,.\, s_2 \tag{21}$$

Then the temperature of the machine at the end of the nth occurrence of condition 1 will be, by (8),

$$t_n = t_l - (t_l - t_l{}^1)(B-1)\left[\frac{1}{A\,B} + \frac{1}{A^2B^2} + \frac{1}{A^3B^3} + \cdots + \frac{1}{A^n\,B^n}\right]$$

$$- (t_l - t_0)\,\frac{1}{A^n\,B^{n-1}} \tag{22}$$

The temperature at the end of the nth occurrence of condition 2 will be, by (10),

$$t_n{}^1 = t_l{}^1 + (t_l - t_l{}^1)(A-1)\left[\frac{1}{A\,B} + \frac{1}{A^2B^2} + \frac{1}{A^3B^3} + \cdots + \frac{1}{A^n\,B^n}\right]$$

$$- (t_l{}^1 - t_0)\,\frac{1}{A^n\,B^n} \tag{23}$$

The limiting temperatures after a long run will be, by (9), at the end of any recurrence of the first condition.

$$t_m = t_l - (t_l - t_l{}^1)\,\frac{B-1}{A\,B-1} \tag{24}$$

At the end of any recurrence of the second condition, by (11),

$$t_m{}^1 = t_l{}^1 + (t_l - t_l{}^1)\,\frac{A-1}{A\,B-1} \tag{25}$$

CASE OF RAPID ALTERNATIONS.

If the period be less than four or five minutes the composite heating and cooling curve approximates to smoothness.

Suppose the first condition of load to be on for k per cent of the time, the second condition for $(100-k)$ per cent, alternating regularly, then $\frac{k}{100}$ corresponds to $\frac{s_1}{s_1+s_2}$ of the previous case.

The limiting temperature after a long run will be, by (12),

$$t_i = \frac{t_l \frac{k}{100-k} \cdot \frac{\mathrm{a}}{\mathrm{b}} + t_l{}^1}{\frac{k}{100-k} \cdot \frac{\mathrm{a}}{\mathrm{b}} + 1} \tag{26}$$

To find the temperature at any length of time, s minutes, after starting find F such that

$$\text{com log } F = \frac{s}{100}\,[\mathrm{a}\ .\ k + \mathrm{b}\,(100-k)]$$

Then the temperature at the time s is, by (13),

$$t_s = t_i - \frac{t_i - t_0}{F} \tag{27}$$

where t_i is found by (26).

These two formulæ, which are approximate, become more nearly correct as the alternations of load become more rapid.

PARTICULAR CASE.—PARTIAL TEST.

In case the value t_i is the only one desired, the value $\frac{\mathrm{a}}{\mathrm{b}}$ in (26) may sometimes be found more simply than by the method given above. The test then becomes

First.—The temperature of the air being t_0, run the machine under the *second* condition of load until a stationary temperature $t_l{}^1$ reached. Of course, if the second condition is one of rest, $t_l{}^1 = t_0$ and this part of the test need not be taken.

Second.—With the temperature of the machine at $t_l{}^1$, change to the first condition of load and run any convenient length of time,

s_{aa}, as 30 minutes, noting the final temperature of the machine t_a^1.

Third.—Run under the *first* condition of load until a stationary temperature t_l is reached.

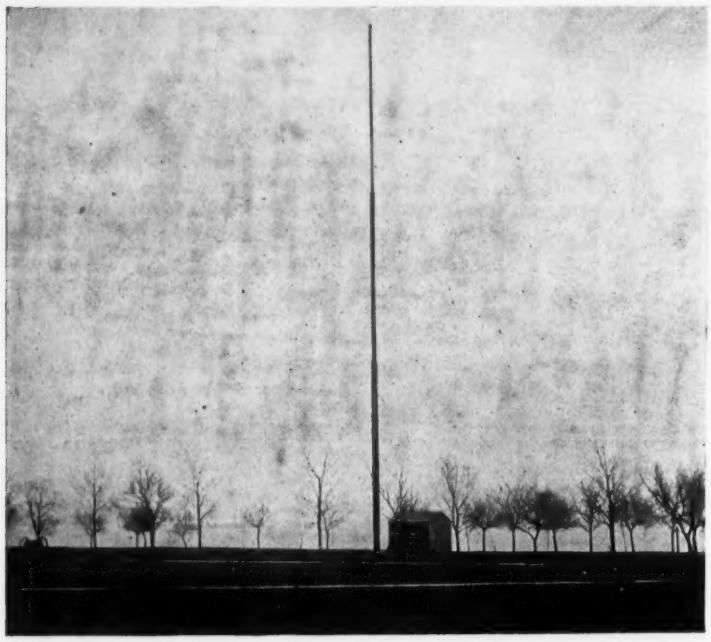
Fourth.—With the temperature of the machine at t_l, change to the second condition of load and run *until the temperature has risen or fallen by the amount $t_a^1 - t_l^1$ already found.* Note the *time* required, s_{bb}. Then the temperature after a long run will be

$$t_i = t_l - \frac{t_l - t_l^1}{\frac{k}{100 - k} \cdot \frac{s_{bb}}{s_{aa}} + 1} \qquad (28)$$

This short cut can be taken only when the conditions are such that a continuous watch can be kept on the changing temperature in the fourth part of the test, as when the test is on some stationary part, or when condition 2 is one of rest.

Wireless Telegraphy in the Army.

The extraordinary demands made upon the Signal Corps of the United States Army during the Spanish-American War have given such a lively impetus to this important branch of our military organization that the results will no doubt be permanent in their effect, and of the greatest value to the army. Extensive as were the augmentations and operations of other corps of the army in the war, yet none was increased to such an extent as the Signal Corps, which was enlarged more than twenty-fold—from 60 officers and men to over 1300. And even this increase was scarcely sufficient



WIRELESS TELEGRAPHY IN THE ARMY.

to meet the incessant demands made by military commanders for communication by telegraph and telephone.

In order to obtain some idea of the great variety of duties and responsibilities of the Signal Corps, it may be well to classify the work under four heads, viz.: Signal Corps instruction, military telegraph lines, supply depots and electrical installations for the control of artillery fire.

It is connected with the second head, the transmission of intelligence, that the officers of the Corps have particularly distinguished themselves in the design of signaling apparatus, comprising the various forms of telegraphic and telephone outfits, and portable saerchlights. Apparatus for army use, besides being portable must be delicate and certain in their operation and still be sufficiently substantial to withstand the rough usage to which they are frequently subjected.

Articles have appeared from time to time in these columns describing and illustrating the numerous electrical devices in use by our army and navy, but little has been written about the details of the various signaling devices which have been developed by military officers, many of whom are well known to the electrical fraternity. Among these might be mentioned Captain A. B. Dyer, Major Greene, Lieutenant-Colonel James Allen, Captain George O. Squier and Captain Samuel Reber, all of whom worked under the general supervision of the chief signal officer of the army, General A. W. Greeley.

The work to which we wish to make special reference this week is the experiments in wireless telegraphy conducted by Signal Corps officers, and the success achieved by them. The Signal Corps has perfected its own system, and it is of interest to record that this system was the first one ever successfully operated in the United States. Prior to Marconi's extensive work for the *New York Herald* the Signal Corps on Sept. 30, 1899, had operated its own system successfully between Fire Island and Fire Island lightship, a distance of about 10 miles. In April, 1900, it opened two stations in New York Harbor, where messages were passed daily to and fro between Governor's Island and Fort Hamilton. This work was originally undertaken by Lieutenant-Colonel James Allen and Captain George O. Squier, and later passed to the hands of Captain Samuel Reber, signal officer, who, with the assistance of Mr. Carl Kinsley, has made many improvements which reflect credit both upon Captain Reber and Mr. Kinsley. As an outcome there have been established and are now in successful operation two stations in San Francisco Harbor, one at Fort Mason and another at Fort Alcatraz, thus covering parts of the San Francisco Harbor over which it has been impossible to successfully maintain cables, owing to its use as an anchorage ground and the entanglement of anchors with the cables. In addition to these installations six complete outfits have been shipped to the Philippines, where they have been in satisfactory operation between military posts and vessels along the coast.

The accompanying illustration shows the exterior of the station on Governor's Island. The pole which is shown in the picture is 150 ft. above the ground, and is built up from wooden planks, the pieces being staggered and bolted together. The pole is securely guyed at three places. The pole at Fort Wadsworth, 7 miles away, is only 90 ft. in height. The transmitting and receiving wireless telegraphy apparatus developed by the Signal Corps was described is our issue of April 20, in the report of the Institute Conversazione, at which the apparatus formed one of the most interesting of the many exhibits.

Developments in Lead Interests.

Attention has been called in these columns recently to developments in lead mining and reduction and their possible relation to storage battery interests. It is now announced that the capital stock of the Union Lead & Oil Company, which was recently incorporated in New Jersey at $15,000,000, is to be increased to $50,000,000, and that the capitalists who are behind this company are arranging a combination of all the Missouri lead properties. The Whitney-Ryan syndicate is understood to be the moving spirit in these operations, which have already penetrated into the fields now occupied by both the Lead Trust and the Smelting Trust. The original purchase of the Whitney-Ryan group of capitalists in investing in lead mines was to obtain a supply of lead for the Electric Storage Battery Company at Philadelphia. But it has been a developing affair, and the mineral lands purchased by the syndicate form a comparatively small area in the heart of the old lead district, following the reports of their experts, and the ore locations fixed by their engineers have been made to include nearly 7000 acres.

The white lead now manufactured by the Lead Trust has been extracted chiefly from silver and copper ores. The Missouri ores are found in limestone and are not accompanied by other minerals, and the statement is made that the consolidation of the Missouri properties will be promptly followed by the erection of four great concentrating plants on the Big River, which are to be connected by railroad with St. Louis. The intervening distance is only about 60 miles.

New processes of extracting the lead from the ores and converting the product into white lead are also announced. The new extracting process is accomplished by electricity. It is developed by the Electric Storage Battery Company. The Big River is relied upon to supply water for furnishing electricity and dams for the control of the water are now being located.

It is said that 500,000,000 tons of metallic lead have been laid bare by the engineers who have been sent to the Missouri lead fields within the last year. More than 20 per cent of the pig lead produced in the United States is understood to come from the Missouri fields.

Death of Mr. John C. Henry.

THE LATE J. C. HENRY.

We regret to note the death in Denver, Colo., of Mr. J. C. Henry, the well-known electric railway inventor and pioneer. For some years past, Mr. Henry, owing to the delicate condition of his lungs, has been compelled to live in Colorado, and when he was last in New York City some months ago he took rather gloomy views as to the chances for his longevity. The sad news is not, therefore, a surprise to his many friends in this section of the country.

Mr. Henry began his electrical career, like so many other well-known men, in the field of telegraphy, but was of an observing and inventive turn of mind, and very early became interested in the subject of traction. About seventeen years ago, when he was in Kansas City, the late Judge W. J. Henry desired to connect Kansas City with Independence, about 10 miles away, and undertook to equip the road electrically, employing plans and devices which young Henry had been bringing to his notice. There is no doubt that Mr. Henry at that time applied ideas which were afterwards destined to become well-known in the art and standard. His plan was to suspend the conductor by span wires supported at each side of the road, leaving the under side of the wire free so that a traveling contact could be maintained with it. His first contact of this character was a little four-wheel carriage which gripped and ran along the under side of the wire, and which was connected with the motor car by means of a flexible cable. Mr. Henry used to claim that the word "trolley," as applied to overhead roads, originated on his Westport section. It was first called a "troller," but this was changed to "trolley" by the employees or public. The car used by Mr. Henry was open, with seats back to back, facing opposite, and it was equipped with a Van Depoele generator used as a motor and developing about 5 horse-power. It was mounted in an iron frame, with variable speed-changing gear, and was supported at one end on the car axles, engaging with the gearing thereon. The motor was series wound and regulated by resistance. The track rails weighed only 12 lbs. to the yard.

In 1885 Mr. Henry repeated his experiments with heavier machinery on some steam railway tracks at Kansas City owned by the Fort Scott & Gulf Railway Company. A little later he equipped the East Fifth Street Railway in Kansas City with four motor cars, each of which had a single 25-hp motor attached to one axle, projecting up through the car, with its working parts in view of the motorman. The motor was connected to the axle by a planetary gear, and the car was operated by two vertical levers, one to apply the regular friction wheel brakes and the other to connect or disconnect the motor from the car. The motor, whose armature ran constantly, and was 18 inches in diameter, built up of laminated iron with Pacinotti projections, was a slow-speed machine. The fields were wound with a multiplicity of small parallel wires bunched together permanently at one end, the free ends terminating in switch contacts so that the resistance of the fields might be varied and the motors regulated without resistance. The potential of the system was fixed at 500 volts, this being deemed safe for all concerned.

After these demonstrations, Mr. Henry, whose work was beginning to attract considerable attention, undertook to build several roads in Southern California, for which all the machinery was built at Kansas City. Although the apparatus was crude, it served its purpose for several years, and the roads, now with later equipments, have become part of the standard trolley systems in their respective localities.

Mr. Henry has stated that on his early motors he employed carbon brushes, but abandoned their use in favor of a comb brush, which worked very well on the rough commutators of those days. The commutators were insulated with fibre, which would not remain solid, so that the carbon brushes chipped and splintered easily.

After this Western work, during which his health broke down, Mr. Henry came on to New York City to take a share in the important electric railway litigations then going forward; and as the result of the money paid him for some of his earlier inventions he was able to establish himself very comfortably at Westfield, N. J. There he turned his attention again to the development of various ingenious inventions and plans for the improvement of trolley systems, but in 1894 his health again failed and he was obliged to remove to Denver. There, with unabated energy, he had been giving his attention to the equipment of standard steam railway systems with electricity, and the perfection of a regenerating controller for use both on trolley cars and electric automobiles. This device has been tried with very satisfactory results, both in Pittsburg and in New York City.

A list of Mr. Henry's inventions, which we happen to have before us, shows 63 patents issued to him from 1886 to 1900. He also had three patents pending, and seven more patents were being prepared for filing at the time of his death by his friend and legal representative, Mr. T. A. Noble. The inventive work of Mr. Henry began as far back as his connection with the Union Pacific Railway Company as one of its electricians, dating from 1869 and lasting 10 years. While there he brought out many valuable improvements, one of which was the Henry velocimeter, afterwards modified by his assistant, Mr. Boyer, into the celebrated speed recorder of that name. Outside of traction, Mr. Henry did little inventing, that subject engrossing his thoughts.

Mr. Henry was only 53 years old, and was born at Woodstock, Ont. His son, who has been brought up in the telegraphic field, inherits a good deal of his father's talent, and has been quite a frequent contributor to the Western press with stories and articles relative to telegraphic and railroad work.

Another Large Independent Exchange for Detroit.

The People's Telephone Company, of the city of Detroit, Mich., has let contracts for the construction of its exchange and contemplates the erection and equipment of the largest single multiple switchboard and central office equipment ever installed in the United States. This contract was awarded to the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The initial switchboard equipment calls for a switchboard to have a capacity for 14,400 subscribers' lines of the multiple lamp line signal central energy type, equipped for the immediate operation of 6000 subscribers' lines, with complete power, battery and ringing equipment in duplicate, with a capacity sufficient for the complete operation of the full ultimate capacity of the switchboard, and 6000 telephones. The bid is said to have been the highest made. The Stromberg-Carlson system is already in use in Rochester, N. Y.; St. Paul and Minneapolis, Minn.; Boston, Mass.; Youngstown and Akron, Ohio; Camden, N. J.; Duluth, Minn.; Waco and San Antonio, Texas; Lexington, Ky.; Wheeling, W. Va., and a great many other smaller cities in the United States. "We placed our order just in time," says Manager Ware, "to get in ahead of Philadelphia and other Eastern and Southern cities, where new telephone companies are figuring with the Stromberg-Carlson people. In fact, we hurried our order to be sure of having our work done first."

The installation date specified in the contract is Feb. 1, 1902. The People's Telephone Company, after a careful search for adequate headquarters, decided that it could only obtain what it wished by buying a site and erecting an exchange building, and accordingly has puchased a lot 80 by 90 ft., located on the southwest corner of Park and Elizabeth Streets. This company's engineers have figured out that this site is within 200 ft. of the telephone center of the city. The building will be six stories in height, modern in construction, and especially designed for use as a telephone exchange. This building is favorably situated, so that it will receive light from the north and east sides, and afford excellent opportunities of bringing the very large and complex conduit system into the building without conflict with the existing conduit systems of other companies. The engineering problem for the installation of such a large system has been very creditably worked out by their consulting engineer, Mr. Max Reber, of Cleveland, Ohio, who has had varied experience in the construction and operation of some of the largest exchanges in the United States.

The underground material will be supplied by the Standard Underground Cable Company, of Pittsburg. The work of underground construction will be commenced at once. The contracts for other materials have not yet been awarded.

A Public Accountant on Municipal Ownership.

At the recent annual meeting of the Illinois Association of Public Accountants, Mr. John Alex. Cooper read an interesting paper entitled "Municipal Ownership from a Public Accountant's Point of View." An abstract follows:

One of the most frequently advanced claims to the benefits to be derived from consolidation of industries or public service utilities, and the most potent argument in its favor, is that of economy. The promoter makes it his mainstay. He has the results neatly figured out and elaborated, until the layman is overborne by their weight, and it is in the preponderance and one-sidedness of such arguments that their effectiveness principally lies. No one can gainsay the points advanced. Nothing can be produced as precedents, and he were a bold investor that would essay a contention to efface the fulsome idealities of a promoter. Much has been attempted in this merging process in the past two years, and it would be an interesting study for the statistician to discover what percentage the gilded facts in retrospect bear to the golden prospects that were so plausibly presented at the start.

It is much the same state of facts that prevails in any argumentation upon the ever-recurring question of municipal ownership of such features of city life as pertain to the public service—light, heat, power, water, traction, telephone, etc. When citizens of any civic community of more or less influence become imbued with the idea that they can do much to benefit their city by agitating for municipal ownership, or any other form of political acquisitiveness, they are not only sure of a certain effective following, due largely to the infectious nature of the hobby, but also owing to the peculiarly isolated conditions surrounding the properties under consideration, they have the double advantage that arises from their own selection of illustrative examples, and from the natural reserve of individual or corporate vested interests upon the question of the net results of their operations.

In our principal cities organizations are being formed for the advancement of this proposition, and such leagues in their co-operative assistance to one another will, perforce, acquire a formidable strength. It therefore behooves the adverse side to not only concentrate their efforts towards combatting the propositions as they may appear, by discovering and arranging their facts and figures as to the physical points, to sustain the counter arguments in general, but also and more directly to the point, as touching the specific properties that the civic authorities may have engaged attention upon, place their affairs upon an uniform recording and accounting plan, that would enable those interested to know at all times their exact standing financially and statistically, and be prepared to exhibit under such uniform conditions the net economic results by direction of influences more favorable than any that could accrue from the variety of schemes of the advocates of municipal ownership. Not only would each property be prepared to meet the discussion fairly and frankly upon its own ground, instead of going far afield, but would also be enabled to at any time compare results with cities of like size, situation and circumstance, to the benefit of the industry.

Municipal ownership, as a theory or as a pet project for political aspiration, will be a perennial plant attracting the zealous study of its advocates more and more as years advance, and as this country acquires prosperity at the rapid rate that has been its fortune in the past few years. What are its opponents doing to meet it? What study is being given to the comparative advantages of private ownership over bureaucracy? Nothing is being done, comparatively nothing. There is no counter league, no cohesion, or association for consideration of the question in all its breadth, and owing to this and the lack of system and want of method in practice, as well as the heterogeneous ways of determining operative results, these industries are most seriously handicapped in every practical way.

Not merely that, there is not the limit of the mischief; for it must be realized by all, both for and against the proposition, that this condition is the most powerful assistant to the purposes of these leagues that could be wished for by them. In this way—assuming that 50 per centum of such public utilities are non-dividend paying (and this is merely for illustration), the owners having no alternative and no data with which to determine the prospects and deficiencies in comparison with like plants, are only too ready in their dissatisfaction to welcome and vote in favor of the "manna from heaven" offered them by the civic authorities in the return of their invested funds.

Is it not, therefore, the part of prudence to be able to localize your argument, so to express it? Instead of amassing statistics, basing arguments and citing instances of other cities, more or less remote and inaccessible, and therefore of feeble argumentative weight, marshal the points and contentions from the returns and statistics of the plant in question, supporting the data by the books themselves, which would be thrown open for the inspection of the advocates and tax-paying community.

It will avail little not to recognize the obvious right of the community to periodical inspection and returns from the books of corporations who are favored with public franchises. We have just seen an instance of this in the United States Supreme Court decision in the case of the Rogers Park Water Works. Acounting and statistical data are more or less effective in proportion to the consideration and method of presentation. If the records conveniently and without laborious effort at the time place the essential material in form required for a series of years, say, four to eight, and the average returns for such period be the logical argumentative points, forcefully and briefly stated, it will rarely be found that the conservative and influential business element of any city will not at once perceive the hazardous nature of the risk proposed of placing such an investment at the service of political transient management, instead of allowing to the owners the modest profit that is their due.

No industry that has been developed within this century has effaced its initial capital by depreciation, or, to express it the other way, by the march of improvements, so rapidly as that of electric public service. Are tax-payers ready to go down into their pockets again and again every time some radical improvement is forced to their notice? the question of merit or expediency being biased by ward exigencies; or, on the other hand, tolerate and be content with the ultra-conservatism that is to-day the greatest drawback that those British cities have to contend with. Would those cities be using horse cars to-day were the franchises owned by commercial investors? Or would Kansas City be at the enormous expense of converting their cable system into electric trolleys were the plants municipally controlled?

Follow this fad, this theoretical folly, to its logical optimistic extreme, and who shall say where the line is to be drawn? And what do we find as the inevitable result? Socialistic apathy and all its attendant evils; the feeding of the wolves at the expense of the industrious bees; the possible absorption of private enterprise in a number of channels, for it only needs the application of the same principles that these advocates advance to see how paving brick, sewer pipe, cement, bridge works, telephone, hotels, hacks, express and transfer service may come to be embraced in the same general category of public utilities. Where should it stop? Who can say?

It makes no difference whether the city authorities acquire the plants by direct purchase or build others with the people's funds. The effect is the same. Where is the gain for a city to acquire all public utilities and thereby reduce its self-supporting constituency, either by political employment or through the burdens of increased taxation?

By way of diversion, the answer can be found in an actual incident. A newly installed park board required an audit of the park accounts, which revealed that although the bond sinking fund had been provided for and regularly paid into the treasury for years by the County Treasurer, there were neither funds nor securities then on hand to show for it. Upon the question being raised at the board meeting the subject was referred to posterity! About the same time electioneering marching clubs being in vogue, every park employee, nolens volens, upon a certain evening swelled the ranks to the loss from the park assets of two spools of copper cable, a squirrel hutch and its lively contents.

The most effective remedy with which to overcome this too constant element in disturbance of corporate profits is in a modern, uniform, concise and economical system of accounting and office statistics, that will not only serve with the utmost promptness every reasonable requirement of the management ordinarily, and without being a burden upon the revenues, but will also be of such a broad, general form or plan as to be amendable to sub-division and reclassification for the especial edification of the staff and servants as occasion may demand, and also display their results sufficiently to meet any of the usual governmental reports.

Upon this question of governmental reports a word or two: By acceptance of a municipal franchise a corporation is obligated to certain statutory requirements, and the time is approaching when annual statements will be demanded by the authorities of most of the

States, somewhat as in Massachusetts to-day; hence a complacent port towards this change would be wise for two strong reasons—first, the files of reports, if arranged under proper preliminary guidance, would be most effective in neutralizing the apparently fair and fulsome examples presented by the advocates of civic management; and, secondly, from such State control the enterprise stands in a good position to demand that municipal competition be estopped.

New York Electrical Society.

Dr. W. E. Geyer, of the Stevens Institute of Technology, has kindly consented to deliver before the New York Electrical Society on May 16, at the College of the City of New York, a special lecture on "Inductance," which will prove of more than usual interest to the members. It will be entirely non-mathematical. The nature of inductance will be explained and illustrated by many striking experiments, the desired effects being made evident to the eye by using incandescent lamps as ammeters and voltmeters. The following are some of the points that will be illustrated: Choking effect, lag, inductance affected by form of circuit, circuit changing its form to make the inductance a maximum, energy stored in circuit, inductance balanced by capacity in series and in parallel. A special circuit will be run into the college to enable the doctor to make his experiments complete, and ladies will be made welcome upon this occasion as upon all others where illustrative demonstrations take place.

National Electric Light Association.

Mr. C. O. Baker, Jr., Master of Transportation, informs us that it has been thought best not to run a special train from New York to Niagara Falls for the convention of the National Electric Light Association, owing to the difficulty of concentrating the delegates, as many wish to be present at the opening exercises of the Pan-American Exposition, while others cannot leave their business until Monday. Arrangements have, therefore, been made with the New York Central & Hudson River Railroad to attach extra cars to their regular trains leaving Grand Central Station at 8.30 a. m. (Empire State Express), and at 8 p. m. (Pan-American Express), either Sunday or Monday. Certificates, entitling delegates to return at one-third regular fare, should be secured when purchasing tickets. Parlor car seats or berths can be secured by applying to Mr. C. Roach, general Eastern passenger agent, 1216 Broadway, New York. Railroad fare is $9.25 going and $3.10 returning. Berth in sleeper or chair in parlor car, $2.

In addition to the programme published in these pages last week we may add another paper by Mr. August Treadwell, Jr., on "Storage Batteries in Central Stations," and an additional topic, "Steam Heating from Central Stations." There are many indications of a lively interest and a large attendance at the convention.

Pan-American Exposition.

Professor G. F. Sever, superintendent of electrical exhibits at the Pan-American Exposition, informs us that Director-General Buchanan has designated Aug. 22 as Electrical Day at the Pan-American Exposition. This fits the time at which the American Institute of Electrical Engineers will be visiting the Exposition for its meeting, accompanied by a number of foreign electrical engineers, who are coming over this year, and it is believed that the occasion can be made one of unusual interest. It is also proposed to work up some special effects for that day which will have at once a technical and a spectacular value.

The official opening of the show postponed by the fierce snowstorms of the latter part of April will now take place on May 20, so that the Exposition will be open just in time for the Niagara convention of the National Electric Light Association; but it is said that 200,000 incandescent lights are already in operation. There was an intention to keep the show open to the public after May 1, but the cold was so intense in the unheated buildings, this was not feasible, and the interval has been availed of to clean up things generally around the grounds and buildings. Last year the Paris Exposition was opened under somewhat similar conditions too early, and it has been desired not to repeat that mistake.

The tests of the effects on the Electric Tower, electric fountains, etc., are reported to be very satisfactory, and the results promise to constitute one of the greatest attractions at the Exposition.

More Niagara Power.

It is officially announced by the Niagara Falls Power Company that it will at once proceed with the development of the power of the Horseshoe Falls under the charter of the Canadian Power Company, which it controls. The contract has been let to A. C. Douglass. The present plan of the company is to develop 35,000 horse-power. One-third of this will be used to operate an industrial establishment outside Victoria Park on the Canadian side. Another third is to be transmitted to Toronto, and the remaining third is to be held in reserve for the use of the Niagara Falls Power Company on the American side of the river. The two power houses of the company in Niagara Falls, N. Y., and the new power house on the Canadian side will be connected.

The plan for development calls for the construction of an inlet canal from Cedar Island to the power house site, where the wheel pit will be sunk, a tunnel carrying the water to the lower river below the Horseshoe Falls. This pit and tunnel will have a capacity of 100,000 horse-power. The Niagara Falls Power Company will finance the undertaking.

A Novelty in Theatre Lighting.

At the northern section of Blackwell's Island, N. Y., the Manhattan State Hospital, of Ward's Island, has an annex for the insane where recently it was decided to have an amateur minstrel entertainment and vaudeville, given by the employees of the hospital for the benefit of the inmates. There are no electric lights at Blackwell's Island, and as they were deemed essential to the success of the entertainment it was found necessary to wire the theatre with 70 16-cp incandescent lamps, which were connected to a main line of flexible wires leading to the dynamo of the steamboat "Wanderer" at the dock 400 ft. distant.

The lights on the boat were turned out to avoid an overload when the circuit was completed through the improvised main line stretched across the dock and lawn to the theatre. The affair was given Wednesday evening, May 1, and it proved to be a success in every particular. This interesting special piece of work was carried out by Mr. Edward Durant, chief electrical engineer of the hospital.

Development of Power at Rochester, N. Y.

The city of Rochester, N. Y., has long been noted for its electrical utilization of water-power, and we now understand from Mr. G. A. Redman that the last mill on Brown's race, known as the Whitney mill, has been transferred to the Rochester Gas & Electric Company. It is understood that the consideration was in the neighborhood of $18,000. The transfer involves also the transfer of three full water rights on the Genesee Falls on Brown's race to the Gas & Electric Company. The present machinery will be removed by the recent owners, as it was not included in the sale of the building and water rights. As soon as the milling machinery has been removed, the building will be fitted up as an electric power and light station. It will be equipped with generators, and its quota of current will be added to that of the six or seven other electric stations already owned and operated by the Rochester Gas & Electric Company in the different races in that city.

The Gas & Electric Company owns several other mill properties on Brown's race, as well as each of the other races, and it is not impossible that some of these also may be transformed into electric stations. The company is the owner of all of the water rights at the lower falls of the Genesee, and also of twenty-seven thirty-seconds of all of the rights on the middle falls of the Genesee. Plans have been perfected for the devlopment of the east side of the lower falls on a basis of 10,000 horse-power. This leaves the west side of the lower falls and by far the greater portion of the middle falls to be developed as called for by the exigencies of future requirements. In this connection it may be noted that the Gas & Electric Company will install a 1400-hp generator, directly connected to a 1400-hp turbine, and an 800-hp generator, directly connected to an 800-hp turbine, in the new brick station which has been constructed at the upper falls.

CURRENT NEWS AND NOTES.

NATIONAL MUNICIPAL LEAGUE.—The next meeting of the National Municipal League will be held in Rochester, N. Y., May 8, 9, 10.

LONG-DISTANCE TELEPHONE IN GERMANY.—Consul Warner, of Leipzig, notes that the long-distance telephone line connecting the cities of central Germany with Frankfort, Kalk, Mühlheim, Cassel and Wiesbaden, in the western part of the country, has been opened for use of the general public. The charge for using this line is 1 mark (23.8 cents) for every three minutes to any one of the above-mentioned places.

PARIS EXPOSITION HONORS.—The following decorations among others have been awarded by M. Georges Leygues, Minister of Public Instruction: Officers of Public Instruction, George Frederic Kunz, special agent to the American Commission; Louis De Goll Rowland, the agent of the telegraph company; Stephen D. Field, a delegate of the Washington Statue Commission; Robert Winthrop Blackwell, Lindon Wallace Bates and R. C. Batcheller, engineering. Officer of the Academy, James S. Anthony, electricity.

STREET RAILWAY IN GUATEMALA.—El Gualtemalteco, official organ of the Republic of Guatemala, publishes the contract entered into by the Government and Senor Don Ramiro Fernandez, in representation of the Urban Railway Company, authorizing the establishment of a tramway between the capital of the nation and the city of Guarda Viejo. The concession carries with it the right to import the necessary cars for the exploitation of the tramway free of municipal duties. The company is obligated to complete the line within five months from the approval of the contract by the Government.

THE ELECTRIC EEL'S VICTIM.—At the Zoological Gardens, says *Chambers' Journal,* a large electric eel was swimming in its tank with more activity than usual, when a big cockroach fell into the water, and in its efforts to get out made a disturbance of the surface, which attracted the attention of the eel. The eel turned round, swam past it, discharged its battery at about 8 inches off, and the cockroach instantly stopped, stone dead. It did not even move its antennæ after. The eel then proceeded to swallow its victim, and the narrator goes on to point out the curious circumstance that the fish, which weighed about 12 lbs., should find it worth while to fire its heavy artillery at a creature an inch and a half long, when it could easily have swallowed it *sans façon.*

SIGNAL CORPS CHANGES.—The following changes in the Signal Corps are ordered from Washington: Major George P. Scriven will proceed to Washington and report to the chief signal officer for duty as disbursing officer in his office, to relieve Captain Eugene O. Fechet, who will proceed to Manila for assignment to duty. Captain Otto A. Nesmith will proceed to Havana for duty as signal officer of that department, to relieve Colonel Henry H. C. Dunwoody, who will repair to Washington and report to the chief signal officer for temporary duty in his office and then for duty as signal officer of the Department of the East, to relieve Captain Samuel Reber, who will repair to Washington and report for further orders.

LONG-DISTANCE TRANSMISSION.—On April 27 the Bay Counties Power Company commenced operating the longest electric power transmission system in the world. The distance of transmission is 140 miles; the lines extending from the water-power electric generating station on the North Fork of the Yuba River, to Oakland, Calif. The load carried was that of the Telegraph & San Pablo Avenues electric railroad lines, of the Oakland Transit Company. At 3 p. m. the 40,000-volt current was switched on in the presence of the officials of the two companies and invited guests. Later a banquet was served at the Bay Counties sub-station in Oakland. Within a few days the street railway company's power stations will be shut down, and the long-distance current depended upon for all of its lines. The 190-mile transmission from the Yuba power station to the Standard Electric Company's San Jose sub-station is about ready to be put in operation.

REFLECTOR INCANDESCENTS.—A remarkable form of an incandescent lamp is the subject of a patent granted April 30 to Jules Edgard de Marcay, of Paris, France. The lamp, instead of consisting of a single globe or bulb, consists of a number of elementary bulbs, each provided with its own filament and grouped about a reflecting body. Each individual lamp is adapted to be placed in or removed from a socket in practically the same manner as are ordinary incandescent lamps. Briefly, instead of arranging in a single bulb one or several filaments, a number of filaments are distributed among independent and interchangeable elements. The patent illustrates a number of forms of lamps. To take one of these as an illustration, a number of lamp elements surround a conical reflector bulb enclosing the elements, being also slightly conical, as shown. There are 16 of these elements which completely cover the surface of the conical reflector.

ELECTROLYTIC REFINING OF ALUMINUM.—There are now in existence or under construction in this country, plants for the electrolytic refining of copper, nickel, silver and gold. In addition there exist operative electrolytic processes for the purification of tin, zinc, antimony, lead and bismuth. The principle of operation is the same in all cases. The impure metal is connected as anode in an electrolyte capable of effecting its solution. Upon the passage of an electric current of a character suited to the particular circumstances, the metal to be obtained, together with all more electropositive metals which may be present as impurities, dissolves in the bath, while less electropositive metals will, within measurable limits, remain undissolved. With properly chosen current density the metal to be refined, being the least electropositive of those in solution, can be deposited in a state of substantial purity. A patent recently issued to William Hoopes and assigned to the Pittsburg Reduction Company deals with this process as applied to aluminum. Crude molten aluminum constituting the anode is contained within a carbon basin, suspended in fused double fluoride of sodium and aluminum (cryolite) to which alumina may be added if desired. With a current density of 20-30 amperes per square inch of anode surface, iron and copper remain unattached, silicon is unattached or volatilized as fluoride, any alkali or alkali earth metals present dissolve and remain in solution in the bath, and aluminum dissolves and redeposits upon the cathode—in this case the carbon lining of the refining tank. The efficacy of such a procedure can scarcely be questioned, but a process involving resolution and deposition of the metal could hardly compete, commercially, with a simple and direct process for the elimination of the impurities from the beauxite which constitutes the raw material for the manufacture of aluminum.

ELECTRIC RAILWAY CONTROLLERS.—Two patents were issued April 30 on electric railway controllers, one of F. W. Garrett and the other to E. W. Stull. The first mentioned is designed to provide a method of series parallel control for two motors, in which the change from field series to field parallel is effected without the use of external resistance, and by a series of steps designed to provide a more even distribution of speed acceleration and also to obviate any tendency of the motors to buck under certain conditions. the motors are changed from series to parallel relation by first connecting their field coils in parallel and their armatures in series with each other, and with the parallel fields, then shifting the connections of one of the motors to place its armature in shunt to the other motor and its field in series therewith, and finally connecting the two motors as a whole in parallel. One of the steps consists in connecting the fields of both motors and the armature of one motor in series, and placing the armature of the other motor in parallel with the first motor. The succeeding step consists in disconnecting the first motor from the circuit and reconnecting it in parallel to the other motor. The Stull patent relates to a method of control which consists in starting a plurality of motors (four or more) connected all in series, and then changing them over to a relation in which they are all in parallel, passing through certain intermediate steps in which the motors are partly in series and partly in parallel. The control is mainly effected by utilizing the resistance and counter e. m. f. of the motors, thus thereby disposing to a great extent, if not altogether, with the use of ordinary external resistance. The controlling elements have also contacts so arranged as to make minor circuit changes preparatory to the essential or running positions, whereby too abrupt changes are avoided and the motor circuits are not entirely broken at any time.

TELEPHONES IN LIBERIA.—Minister Smith reports from Monrovia, Feb. 26, 1901, that Mr. T. J. R. Faulkner, a civil engineer from the United States, has placed that city in telephonic communication with White Plains, a settlement 25 miles up the St. Paul's River. This is the longest line in the country.

ANGLO-GERMAN COURTESIES.—The English Institution of Electrical Engineers is to visit Berlin on June 23 to 26, as the guest of Siemens & Halske and the Allgemeine Elektricitäts Gesellschaft. Many of the members will then proceed to Dresden to attend the annual assembly of the Verband Deutscher Elektrotechniker, which takes place this year in that city.

THE NEW FRENCH "HELLO!"—"Hello! hello!" has been the signal both of the telephoner and the telephone girl in every country where the invention has been adopted. France is going to break with this uniform custom. According to new instructions just issued, girls in the central telephone exchange must use the formula *"Je vous écoute."* Those who are familiar with colloquial French know that the emphatic *"je vous écoute"* corresponds somewhat to "you bet." The merriment provoked by this latest innovation of M. Mougeot, the under secretary of the Postal Telegraph Department, will easily be understood.

ELECTROLYTIC RECTIFIER FOR ALTERNATING CURRENTS.—The asymmetric cells or current rectifiers of the type discovered by Buff, developed by Ducretet, applied to the rectification of alternating currents by Hutin and Leblanc, and of late associated with the names of Pollak and Graetz, have now been further modified by Pollak, who finds that their efficiency is greatly increased by substituting for the usual electrolytes, a solution of an organic acid or its salts. These cells comprise one electrode of aluminum, and one of lead, copper, carbon or other indifferent conductor, and permit an electric current of moderate voltage to pass in one direction only—the electrical analogue of the check valve. When the aluminum functions as cathode, the current passes freely, but in the reverse direction it is nearly or completely checked until a certain definite voltage—largely dependent upon the electrolyte—is reached, when the cell breaks down. The inventor states that by a proper preparation of the plates they may be made to withstand 500 or more volts. He adheres to the earliest and perhaps least satisfactory explanation of their operation—that an actual insulating layer is formed when the current passes to the aluminum electrode as anode, and is destroyed when the current is reversed.

LETTERS TO THE EDITORS.

Copper-Cadmium Batteries.

To the Editors of Electrical World and Engineer:

Sirs.—In view of the interest displayed by the electrical public in the new Edison copper-cadmium-alkaline storage battery, it may not be out of place to call attention to the fact that, assuming the battery to be successful in general, and quite free from any serious tendency to rapidly depreciate, yet even so, Mr. Edison's claims are not extraordinary, because his promise is to double the output of the "Manchester chloride," or to give the output of the "Manchester chloride" battery with half the weight. This, I say, is no great invention, because the battery above cited has an output value equal to 3 amperes per pound at best. There are several batteries now to be had that do double this work, as, for illustration, batteries like the "Gould" special, of the Plante genus. While there are batteries of the Faure genus, such as "Taylor," "Sperry" and others that produce nearly three times that output; or, in reality, nearly 50 per cent more than Mr. Edison promises. This being so, Mr. Edison promises nothing unless it is to do better in the way of depreciation, and promises of this nature, especially before they are substantiated by at least a year of service, are rather to be discounted. There are formidable difficulties to be surmounted in the battery of the school to which Mr. Edison's battery belongs, and while it is to be hoped that the Edison battery will improve with age, rather than depreciate, yet even so the public will, in the judgment of the writer, be perfectly safe, even warranted, in giving the lead-sulphuric acid types of batteries some further consideration before banking on the new possibility. If for no other reason, then because "we know the devil we have."

THOS. J. FAY.

[The copper-cadimum battery is but one step in Mr. Edison's work, and is the only portion so far made public.—EDS. E. W. & E.]

Professional Training in Commerce.

To the Editors of Electrical World and Engineer:

Sirs.—Dr. H. S. Pritchett, president of the Massachusetts Institute of Technology, recently read a suggestive paper before the New England Cotton Manufacturers' Association, in which he advocates the givng of a professional training to men who desire to become eminent in commerce. As Dr. Pritchett rightly points out, "The changed conditions of to-day indicate that a man ought to be educated in some broad view of the relation of men to each other, if he is to assume administrative duties in affairs of large magnitude." Further on he says, "The time is near when those who are to direct great organizations, who are to control and develop manufactures, who are to trade between nations—in a word, the captains of commerce—must look upon their calling as a profession, not as a business; and for this profession there is a training to be had which will not only save time for the individual, but which will develop a broader, a more efficient and a higher type of man; a training which will bring not only a keener vision, but a wider outlook and a better perspective."

How far is it possible, from our present outlook, to realize the ideals set forth by Dr. Pritchett?

If we take the electrical industry, for example, we find that 20 years ago men were rushing into it from all sides, most of them without any special technical training. To-day the junior ranks of this same industry are being replenished chiefly with graduates of the various technical colleges throughout the country. Yet the change has not been from narrowness to breadth, but rather the contrary. The all-round man of 20 years ago had at least the breadth which came from a varied experience in the actual world, while the technical college graduate of to-day "specializes" in college as a preparation to being still more highly specialized as a small cog in some big manufacturing machine. And for all we can see, the intensification of specialization may go on until every man in the great industrial army of the United States, whether college-bred or not, will be wearing a set of intellectual blinkers which will effectually limit his vision to the narrow path in which he has been trained. But this end is unthinkable, if we desire at the same time to preserve industrial efficiency. We all know how apt the specialist in bodily diseases is to find all his patients suffering from the malady which he has made it his lifework to cure, and those who have gained wisdom never go near a specialist except on the advice of the family physician who picks out the right man to whom to go. In like manner, if the electrical industry encourages specialization to the point where it is the rule and not the exception, the time will assuredly come when "unspecialized" men with brains and experience will be sought for outside the ranks of the electrical industry to run it on a paying basis.

Take this country all through and you will find no class of men equal in energy, resourcefulness, business ability and promptness of decision to the presidents of its railroads, and yet were ever a set of men drawn from more various sources, with such diverse experiences, and so little technical education? As the railroad industry is much larger than any other in this country, its need for the assistance of the technical colleges ought to be correspondingly great. The fact remains, however, that our railroad presidents, with few exceptions, have begun life either as rodmen, firemen, brakemen, freight clerks or telegraphers. If presidents of electrical concerns, whether manufacturing or operating, were to be derived from similar sources they would begin life as motor men, lamp cleaners, office boys or mechanics' helpers.

I do not cite these examples because I disagree with Dr. Pritchett in his main idea, namely, that the captains of commerce should arise from men who have secured a professional training toward that end. On the contrary, I am thoroughly in sympathy with his aim, though I believe that the course of study in the technical colleges will have to be revolutionized if he and other educators are to achieve it. I devoutly believe that the technical college is the place in which principles should be instilled into a young man's mind, so that he would

find in the factory, in the draughting room, in the sales room, a continual exemplification of these principles in after life. It may be that the history of mechanical invention is taught in technical colleges, though I never was fortunate enough to meet a student who had studied this branch of knowledge. It may be that more practical parts of political economy, such as the rise and fall of prices, the marvelous trade shiftings of successive generations, the changes brought about in the world's history by new discoveries, are part of a technical college student's course. How many students know enough about the physical sciences to be able to read and to enjoy Herbert Spencer's "First Principles," which gives us such a magnificent general view of their inter-relations? In short, the function of the technical college ought to be a training of the mind, a stimulating of the scientific imagination and a deepening of historic insight, so that men might be able to predict the future from their knowledge of the past, and might be able calmly to grapple with the present with a sure knowledge of its underlying principles.

NEW YORK, N. Y. A. L. NOSTRAND.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Starting Resistances for Direct-Current Motors.—BUNET.—A long mathematical article on the calculation of the single steps of rheostats used in starting direct-current motors. He first solves the problem of how to choose the single resistances of the rheostat if the process of starting shall be as follows: The lever of the rheostat is set on the first notch, the current shall be I, which is the maximum current allowed; the motor then begins to start and a counter e. m. f. is developed, so that the current decreases to i; by moving the lever of the rheostat to the second notch, the current increases rapidly again to I, and then decreases again to i; the same shall be the case with all the other notches so that the current varies between the limits I and i. He shows that this is a very satisfactory method of starting, and the more satisfactory the smaller the difference between I and i. Let $A, B, C \ldots N$ be the n resistances determined by the positions of the sliding contact lever of the rheostat upon the n notches, comprising the resistance of the rheostat and the motor, so that N is the resistance of the motor alone. He shows that the above method of starting is obtained, if the ratio $I \div i$ is equal to the ratio $A \div B$, and the ratio $B \div C$, etc. He then gives a simple formula for determining the number of notches in this case, if I, i and the e. m. f. of the circuit and the internal resistance of the motor, are given. He then gives a numerical example: A motor has an internal resistance of 0.05 ohm and is operated in a circuit of 100 volts; the maximum current I is fixed at 200 amperes; if the lower limit i of the current is assumed at 180 amperes, 23 notches are required; for $i = 150$ amperes 9 notches, for $i = 100$ amperes 4 notches. In the second case, with 9 notches, the resistances of the rheostat are 0.45, 0.325, 0.231, 0.161, 0.108, 0.069, 0.039, 0.017 ohm. He then shows how to calculate the time which is required for the contact with each notch. He considers the case of a car, in which a torque is required independent of the speed, and shows that the time from the contact on first notch to the contact of the second notch must be to the time from the contact on second notch to the contact of third notch, as I to i; the time for the contact on each notch decreases in a geometrical proportion. This result can be utilized in the construction of the rheostat by making the contact notches smaller and smaller, according to this geometrical proportion, and by giving the rule to the motorman to turn the lever with constant speed. He finally deals with the case that the power varies, and considers the case of starting a motor at any load, for instance, on a car where the resistance to traction to be overcome varies greatly. He proposes to handle the lever of the rheostat so that he speed of the car is always the same for the same notch of the controller. He develops the formulas of this case.—*L'Ind. Elec.*, March 10.

Slotted Direct-Current Armature Windings.—ROTHERT.—An illustrated article on the development of direct-current dynamo design in recent years in Europe. Some years ago the American direct-current machines were elctrically much better than those built in Europe, especially regarding the dimensions of the armature. In recent years European designers have begun to follow the example of the Americans. He deals with "newer windings for slotted direct-current armatures." Only series windings are considered. The article deals mainly with designs based upon the use of two or three commutator segments per slot. In Europe it had until recently been nearly general practice to use as many commutator segments as armature slots.—*Elek. Zeit.*, April 11. A similar article by the same author in *L'Eclairage Elec.*, March 30.

Converters.—EBORALL.—The conclusion of his paper on polyphase sub-station machinery, noticed before in the Digest. It is also commented upon in an editorial. An account is also given of the discussion which followed. Field did not agree with Eborall that the proper place for damping copper pieces is only between the pole-tips and that they are useless elsewhere. Many makers surround the pole with a massive ring, which is thickened up at the pole tips, the poles being often chamfered off at the tips, and the copper rings are arranged to enclose the tips, so that part of the polar surface is made of copper. Normally, the whole pole flux passes through the ring, and in order for it to be blown out into the intervening space between the pole tips it would have to cut across the ring. S. P. Thompson agreed with Field that there is some advantage in putting a thick copper coil around the pole, but he did not stop there, because this did not secure the whole advantage. There might be a reaction due to a lagging or leading current which tends to distort the magnetism to one side of the pole producing an unequal distribution which would be sufficient to admit of hunting. He considered the real remedy to be an amortisseur on the plan adopted by Leblanc with a number of closed copper circuits so that there are circuits through the pole faces as well as around them and between them. The large 3000-kw machines exhibited by the Gen'l Elec. Co., of Berlin, at the Paris Exposition had the pole pieces pierced with five holes of different sizes from front to back and copper rods inserted in each hole. The ends were all short-circuited together, making practically a squirrel cage embedded in each pole.—Lond. *Elec.*, April 19.

Friction and Hysteresis Losses in Three-Phase Induction Motors.—DETTMAR.—A communication in which he criticizes the paper of Hissink, abstracted in the Digest, April 13. He claims that Hissink's explanation of the difference between measurements and calculations of the hysteresis and eddy current losses cannot be correct. Hissink had suggested that the difference might be due to the increased friction losses. The present author had found that the friction of the bearings is practically independent of the load. He says that the difference between measurements and calculations is due to two reasons. First, the iron losses are generally calculated by a wrong method; second, there is a non-uniform distribution of the lines of force where they leave the teeth. (See his paper, abstracted in the Digest, Dec. 15, 1900.)—*Elek. Zeit.*, April 4.

Modified Induction Motor.—OSNOS.—A communication referring to the article of Grob (Digest, March 30). He remarks that the Grob motor ought to be considered as a special case of a synchronous motor. It is not fair to compare it with an induction motor, as the Grob motor is not self-starting. He gives a comparison of the Grob motor with a synchronous one. This shows that the former compares less favorably than might seem at first sight.—*Elek. Zeit.*, April 4.

Standardization of Electric Apparatus.—PARSHALL.—An article in which he attempts to outline in a general way the conditions of output which should be defined to insure a given result as to efficiency and maintenance. The thermal limit of output may be defined as the maximum temperature consistent with the durability of the insulation of the electric circuits and the maintenance of the commutator or collector rings in the best working condition. The magnetic limit of output is determined in commutating machines by sparking, and in alternators, synchronous motors, induction motors and transformers by regulation and maximum output. The inherent regulation is defined as the ratio

of no-load to full-load voltage without change of excitation. He further discusses regulation by compounding, definition of efficiency and insulation. He refers to the "very elaborate report as to a plan of standardization prepared and adopted by the American Institute of Electrican Engineers." He says that a similar code is also being considered by a number of leading experts in Germany, but that the standardization proposed is not in general agreement with the American standards, in that it is suggested that less stringent regulations as to heating and sparking should be permissible in practice—that is, a greater increase of temperature should be permitted, and a certain shifting of the brushes should be allowed in commutating machines to avoid sparking for a change of load. "What is really wanted is an international code of standardization so that the standards of one country shall not be below those of another."—*Traction and Transmission* (London); *West. Elec.*, April 27.

REFERENCES.

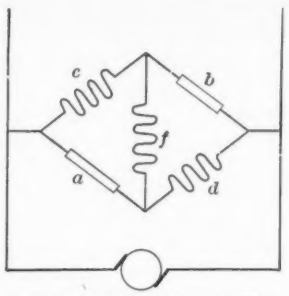
Sparkless Disconnection of Shunt Motors.—MUSSWITZ.—A communication in which he criticizes some special points in the article of Krause, noticed in the Digest, April 13.—*Elek. Zeit.*, April 4.

Rotary Transformers.—COLLES.—A continuation of his long paper. He discusses stationary apparatus for the transformation of polyphase currents, and then takes up the rotary transformer. He discusses the two-coil transformer and the single coil rotary transformer, and then gives the theory of the latter apparatus.—*Jour. Frank. Inst.*, April.

Large Generators.—ROTHERT.—A reply to the recent communication of Pichelmayer. He thinks that the Arnold winding will soon be introduced into American practice. He also makes some remarks on the question of how much overload generators should be expected to stand.—*Elek. Zeit.*, April 11.

LIGHTS AND LIGHTING.

Nernst Lamp Pre-Heater.—An illustrated description of devices of Raab for automatically lighting a Nernst lamp. The principle is based upon the arrangement of the Wheatstone bridge and may be seen from the adjoining figure. *f* is the heating body and *a* and *b* are the incandescent bodies; *c* and *d* are two resistances of proper value. When the lamp is switched on, the incandescent bodies do not conduct the current, and the current flows through *c f d;* the heating body *f* then heats the incandescent bodies *a* and *b,* and the latter become conductors, the current then goes partly through *c b* and partly through *a d,* until finally no current at all or a very small current flows through the heating body *f,* according to the principle of the Wheatstone bridge. Several modifications of this device are also described and illustrated.—*Zeit. f. Beleucht.*, April 10.



NERNST LAMP PREHEATER.

Bremer Arc Light.—A note on this lamp which was described in a paper of Wedding, abstracted in the Digest, July 28, 1900. In the meanwhile, the lamp is said to have been perfected and to have been examined by other experts. Some notes are given from a recent lecture of Bremer. The lamp has been tested by Janet in Paris, who found, in accordance with Wedding, that the Bremer arc lamp consumes 0.17 to 0.1 watt per candle, i. e., one-third to one-fifth of the consumption of other arc lamps. The consumption of the carbons is said to be not greater than that of ordinary arc lamps. For the latter Heim found on the average 0.42 cb. cm. for the positive side and 0.17 cb. cm. for the negative side per ampere-hour. Wedding found for the Bremer lamp 0.25 cb. cm. on the positive side and 0.12 cb. cm. on the negative side.—*Elek. Zeit.*, April 4.

Electric Light of the Future.—E. H.—An article on the sources of electric light of the future. He gives a review of the subjects of the Bremer arc lamp and the Rasch electrolytic arc lamp, also of the Nernst lamp and the Welsbach osmium lamp, all of which were noticed before in the Digest. Regarding "luminescence" as a source of light, he says that a solution of the problem cannot be thought to be impossible because the experiments so far made have been unsuccessful. A brief review is given of Tesla's high-frequency experiments.—*L'Ind. Elec.*, March 25.

POWER

Electric Power in a Glass Plant.—FROELICH.—A well-illustrated article on the electric installation at the works of the Edward Ford Plate Glass Company, of Toledo, which is the first plate glass plant to operate its grinding and polishing machinery by electric power. Each of the 24 grinders and 20 polishers is connected with a three-phase induction motor. The grinders each require a 100-hp and the polishers a 150-hp motor. All the motors run at two speeds. At slow speeds the poles of the stator are all joined in series and at full speed the poles are joined in parallel reducing the number of poles just one-half.—*Rose Tech.*, April.

Polyphase Equipment of Factories.—WYLD.—An abstract of a paper read before the Birmingham section of the Brit. Inst. of Elec. Eng. After an elementary discussion of the properties of induction motors, he gives a detailed list of polyphase factory plants, which is summarized as follows: The United States has five plants, aggregating 7130 horse-power, Germany 15 plants of 7685 horse-power, Switzerland 9 plants of 5850 horse-power, Italy 22 plants of 12,035 horse-power, Russia 16 plants of 12,700 horse-power, England 16 plants of 9450 horse-power, etc. The total for the different countries is 105 plants, aggregating 68,000 horse-power.—*Lightning*, April 18.

REFERENCE.

Montgomery.—ABELL.—An illustrated description of the water-power plant of Montgomery, Ala. There are three turbine-driven, 875-kw, three-phase alternators. The transmission line is 30 miles long.—*West. Elec.*, April 27.

TRACTION.

Electric Traction in France.—SOULIER.—The ninth annual table of statistics, giving data for the electric railways and tramways in service or in course of construction in France on Jan. 1, 1901. There are six full-page tables, giving a large amount of information. The total length of lines has increased from 753 km. in 1900 to 1486 km. in 1901; the total capacity from 28,300 kilowatts to 64,400 kilowatts; the total number of motor cars from 1295 to 2425; the number of lines using the trolley system, from 56 to 76; the number of lines using the conduit system from 3 to 6; the number of third-rail lines from 1 to 4; the number of lines with the pure accumulator system from 6 to 8; the number of lines with the combined accumulator and trolley system from 4 to 6; the number of lines with the combined trolley and conduit system from 2 to 2; the number of lines with the combined trolley and surface contact system from 0 to 7.—*L'Ind. Elec.*, March 25.

Accumulator Traction in Italy.—LANINO.—A long abstract of a paper read before the Italian Electrotechnical Society, on the railway between Bologna and San Felice, a distance of about 26½ miles, where accumulator cars are used. The line serves to connect numerous small agricultural centers, the passenger traffic and the goods traffic are extremely limited. Some details are given regarding the construction of the cars and the Pescetto storage batteries used. Each car contains 288 cells, each weighing 73.6 lbs. The battery in each car has a capacity of 300 ampere-hours, equal at a main pressure of 600 volts, to 180 kilowatt-hours, with an average discharge of 200 amperes. This capacity was intended to furnish sufficient energy for a complete journey out and back in all conditions of weather. It actually enables the car to run a distance of 62 miles under ordinary conditions. No results are given regarding the financial side of the undertaking.—Lond. *Elec. Rev.*, April 19.

Electricity on Main Lines.—KRANOLD.—A brief communication denying the correctness of a former notice which stated that the cost of operation on the Wannsee Railroad, near Berlin, is less by about 10 per cent, since the introduction of the electric service, than it was with steam. He says that exact figures cannot yet be given, but from the present statistics it appears that the cost of operation with electricity is higher than with steam. "Already the cost of current alone is considerably higher than the cost of fuel for the same transportation with the locomotive service."—*Elek. Zeit.*, April 11.

Convention of Street Railway Association.—An account of the convention held at Strasburg, Feb. 13, of the Associations of the Rhineland, Westphalia and neighboring districts. The subjects of fenders, vestibules, transportation of freight, municipalization of street railways, sandboxes, rails and commutation tickets were discussed. The Hanover Company reported the use of 30 freight locomotives and

gross receipts from freight of over $125,000. An electric locomotive can draw four cars, each loaded with four tons, and requires only two couplers. The locomotives require about 50 watt-hours per ton km., and the cost per kilowatt-hour is about 4.7 pfennig, which is a little over one cent. The gross receipts are about 54 pfennig per car km. It was decided to compile some statistics showing the bad effects of the municipalization of street railways. The purchasing of coal in bulk by a number of the companies was discussed. The next meeting will be held at Aix-la-Chapelle.—*St. R'y Jour.*, April 6, Int. Ed., April.

Multiple Unit Systems.—SOULIER.—An article on the electric railway from Faget-Saint-Gervais to Chamonix. Water-power will be utilized. Trains consisting of a number of electrically-driven motor cars will be run. For the control of the whole train a system of "servo-motors," operated by compressed air, will be used, by which a motorman in the front car operates the controllers of the different motor cars. This system is described and illustrated.—*L'Ind. Elec.*, March 10.

REFERENCES.

Three-Phase Traction.—GALMOZZI.—A long mathematical article in which he develops some simple formulas for the voltage drop and the phase differences in the currents in each phase of a three-phase traction line. They are in general different in the two overhead conductors from those in the rails, i. e., the three phases are not equally loaded. He then gives the analogous formulas for a two-phase system with the rails as common return.—*L'Eclairage Elec.*, March 30.

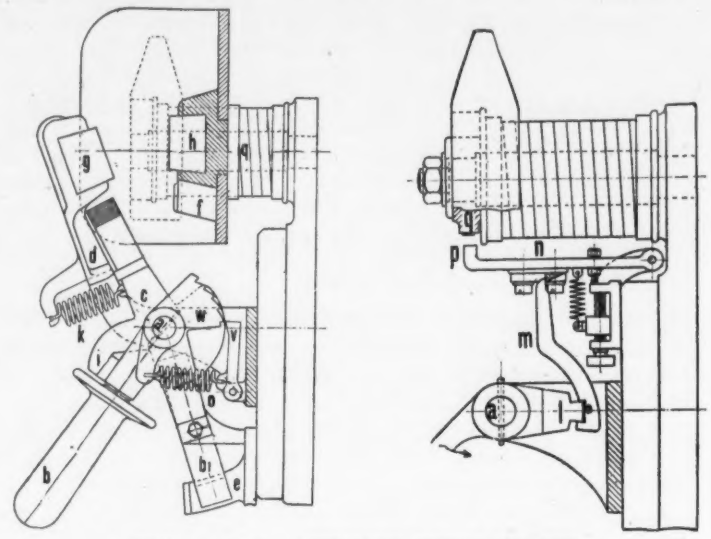
Jungfrau Locomotive.—A description in detail of the Jungfrau three-phase locomotive No. 4. Its features, which distinguish it mainly from the older locomotives of the same road, is the direct-current excitation of the induction motor, for use on descending grades.—*Elek. Neu. Anz.*, April 1.

Isle of Thanet.—An illustrated description of the new British tramway line of the Isle of Thanet. The length of track is 11 miles. The power house contains two direct-current, 500-volt traction sets and two 2500-volt 50-period three-phase generators. The three-phase currents are transmitted to synchronous converter sub-stations.—Lond. *Elec.*, April 19.

Conduit Systems.—Some illustrations, with brief description, of conduit constructions in Paris and Nice.—Lond. *Elec. Rev.*, April 19.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Automatic Circuit Breaker.—NATALIS.—An illustrated description of a new circuit breaker of Schuckert & Co. He says that most of the circuit breakers on the market have the following disadvantage: When the apparatus has broken the circuit it may be that the overload is still in existence when one is resetting the circuit breaker. If in resetting one holds the circuit breaker closed by the hand even for a moment only, the overload may do damage to the apparatus. To prevent this danger it has been suggested to use a special hand switch besides the automatic switch. When the circuit breaker has broken the circuit, one has first to open the hand switch, then to close the automatic circuit breaker, and finally to again close the hand switch. In this way there can be no accident, but there is danger that an unskilled attendant might forget to open the hand switch first. In the circuit breaker which he describes these disadvantages are overcome. The circuit breaker is illustrated in the adjoining figures. Around a common axle *a* are movable both the hand switch *b b* and the automatic circuit breaker *c d*, which is released electromagnetically. The switch *b* is provided with copper contacts for making connection with both *c* and *e; e* is the one terminal by which the current is fed into the apparatus. The automatic circuit breaker consists of a main switch *c* provided at its end with copper contacts for making contact with the surfaces *f*, and of the arm *d*, provided with a carbon contact *g* which is pressed against the carbon contact *h*, electrically connected with *f*. Only the switch *b* is provided with a handle *b;* when it is opened the arms *c* and *d* are raised by means of *i*, and the contacts between *g* and *h* and between *c* and *f* are closed. The switch *c* is held in this position by the device *l m n*, seen in the second figure and described below, so that the hand switch *b* can now be lowered again, which closes the circuit. The whole manipulation therefore consists of raising the handle *b*, which opens the circuit at *b*, and closes the upper automatic circuit breaker, and of lowering again the handle *b*, which closes the circuit at *b*. As seen in the second figure, the handle *c* and the handle *l* which is firmly connected with *c*, are held in their position against the action of the spring *o* by means of the armature *p* of the electromagnet *q*. But in order to avoid that the whole pressure of the strong spring *o* acts upon the knife edge *n*, the lever *m* is provided, which grasps around the lever *l* so that only a small part of



FIGS. 1 AND 2.—AUTOMATIC-CIRCUIT BREAKER.

the pressure of the spring *o* acts upon the knife edge *n*. In this way it is possible that a relatively small e. m. f. releases a considerably larger force. The two arms of the electromagnet *q*, one of which attracts the armature *p*, are surrounded by a few windings of the main circuit. The circuit is broken only by the switch *c d*, provided with an apparatus for magnetically blowing out the sparks. In order to open the circuit breaker by hand, the armature *d* is provided with an insulated handle. It is impossible to open the switch *b* while the automatic circuit breaker is closed. This is done by the arresting device *v w*, seen in the first figure. Sparks should occur only at the contacts *g h*, which consist of carbon of the very best conductivity.—*Elek. Zeit.*, April 11.

Safety Device.—GOERGES.—A brief illustrated paper read before the Electrotechnical Society, of Berlin, on a new safety device of Siemens & Halske. He calls attention to the importance of devices for preventing the dangers due to the passing of high voltage into low-voltage circuits. When in a step-down transformer supplying a number of lamps, any point of the low-tension winding makes contact with a point of a high tension winding, there is danger. To prevent this danger, he connects one point, for instance, the middle point, of the low-tension winding of the transformer with the earth through an air-gap. The apparatus used for this purpose is described and illustrated.—*Elek. Zeit.*, April 4.

British Alternating-Current Central Stations.—The large annual table giving a list of the high-pressure alternating-current plants in Great Britain. There are 72 provincial plants and 12 plants in London. No summary is given. The largest plant has an actual capacity of 4320 kilowatts, the smallest one of 42 kilowatts. Ten plants use both alternating and direct current; 26 plants use a frequency of 100 or above; 33 a frequency of 60 or above, 21 a frequency below 60; 4 plants are for different frequencies.—Lond. *Elec. Rev.*, April 19.

REFERENCES.

Central Station Equipment.—JUNKERSFELD.—An abstract of a lecture delivered before the Engineering College of the University of Illinois. He discusses the transmission of 25-cycle, three-phase currents and conversion into direct current in sub-stations. He also speaks of the use of double-current generators in Chicago. One of the more recent developments in the distribution of alternating current has been the four-wire, three-phase system in one of the outlying districts of Chicago. He says that the steam turbine at present gives promise of revolutionizing power-station design. He also expects promising developments from the Nernst lamp.—*West. Elec.*, April 27.

Compound Dynamos in Central Stations.—WILLE.—The first part of an illustrated article in which he gives illustrated descriptions of successful installations, in which compound-wound direct-current dynamos are used as generators for light and power service.—*Elek. Anz.*, April 11.

WIRES, WIRING AND CONDUITS.

Anchors for Electric Wiring Poles.—CARPENTER.—An illustrated account of tests made of the holding capacity of a certain type of anchor for electric wiring poles, namely, the Stombaugh Guy Anchor, which consists of one full helix or screw thread of cast iron, attached either to a long iron bar or a guy wire. The holding power in clay is greater than that in sand. He gives an empirical formula for the holding power in sandy ground. The resistance, offered by the anchor, in pounds, is 100 times the diameter of the helix of the anchor in inches, multiplied with the square of the depth of the helix, in feet, from the surface. The resistance in clay would probably be 20 per cent more.—*Sibley Jour.*, April.

ELECTRO-PHYSICS AND MAGNETISM.

Electromagnetic Coils and Plungers.—RANKIN KENNEDY.—An article illustrated by diagrams. He treats the coil and plunger as an electromotor and discusses several types. He recommends making the coil wide and thin, and to use soft iron tubes inside and outside, connected by a circular yoke, the outer tube forming a mantel over the coil. This is a scientific construction of the horseshoe type

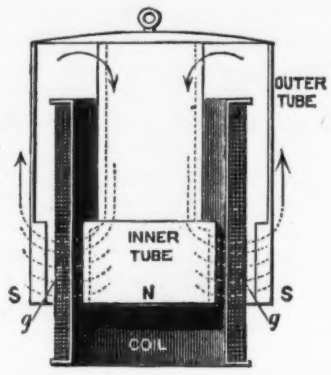


FIG. 1.—COIL AND PLUNGER.

of plunger. It is illustrated in Fig. 1. "We are now coming nearer to a series-wound motor. The wires in the air-gap at *g* are armature conductors, those above the air-gap the field winding." By making the tubes thin enough above their polar faces, they can be saturated magnetically so that the pull will be proportional to the current. If the coil is divided into two coils, one an armature and the other a field coil, it is possible to pull the plunger up or down by reversing the current in either half. A further development leads to the construction of a coil and plunger of the shunt motor type, a main coil forming the armature and a fine wire shunt coil forming the field winding, together with an outer and inner tube with polar faces. There is a constant field, and the plunger may be driven up or down, according to the direction of the currents in the coils. Another modification of the coil and plunger, which is described to give a long range of equal pull or push of small force, consists of a long solenoid with a still longer plunger. The plunger carries a magnetizing coil wound in two sections, producing a pole in the middle. The sectional area of the plunger and the power of the magnetizing coil must be so designed that the plunger is magnetically saturated by its own coil. A current in the long solenoid outside will pull with a long, equal range, either up or down, according to the direction of the current in the coil. In Lord Kelvin's recording instruments this coil and plunger is used. A very powerful coil and plunger for a machine for striking a heavy blow is shown in Fig. 2. The coil is iron clad, and has two ring-shaped inner poles, *N, S,* and a plunger to loosely fit the bore. This plunger has cut into it a series of grooves in which the armature winding is wound, to produce a pole in the middle and one at the end. The length of the core is equal to the length of the ironclad coil plus the length of the stroke.—Lond. *Elec. Rev.*, April 19.

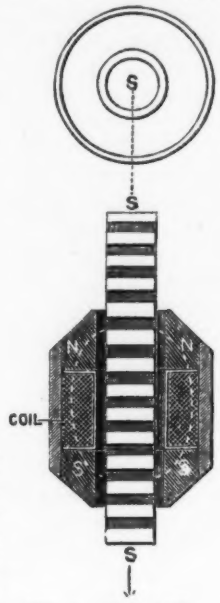


FIG. 2.—COIL AND PLUNGER.

REFERENCES.

Electric Arc.—BERMBACH.—The first parts of a paper in which he gives a summary of our knowledge of the physical phenomena in the electric arc.—*Elek. Anz.*, April 14, 18.

Theories of the Coherer.—TURPAIN.—A critical review of the theories of the coherer, suggested by Branly, Lodge, Righi and Ferrie. He shows that all these theories are not general enough. Each one relates only to a special group of radio-conductors and not to the others.—*L'Eclairage Elec.*, April 13.

Disruptive Discharges.—JOHNSON.—A long, mathematical article, in which he discusses the conditions, under which disruptive discharges can occur.—*L'Eclairage Elec.*, March 16.

Earth Currents.—FOERSTER.—A paper read before the Electrotechnical Society, of Berlin, in which he gives an account of a very long series of measurements of earth currents, extending over about 10 years, made on two German telegraph lines.—*Elek. Zeit.*, April 11.

ELECTRO-CHEMISTRY AND BATTERIES.

REFERENCES.

Reducing Action of Calcium Carbide.—KUEGELGEU.—The first part of an article in which he discusses the use of calcium carbide as a means of reduction. In this part he gives an account of his experiments in which he used calcium carbide for the reduction of lead oxide at 800 to 900 degs., or 1000 to 1100 degs. C., for the reduction of lead chloride and of mixtures of lead chloride and lead oxide.—*Zeit. f. Elektrochemie*, April 11.

Electro-Chemistry in 1900.—KRUEGER.—A continuation of his review. This part deals with pyroelectro-chemistry, and the progress in the alkaline industries and in other anorganic chemistry.—*Elektrochem. Zeit.*, April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Meter for Double Tariff.—An illustrated description of a meter for double tariff of Schuckert & Co., to be used by stations which charge different rates for the electric current at different hours of the day. The meter consists essentially of a clock and a motor meter, mounted on a common base. The clock is an ordinary pendulum clock with electric winding. It operates a needle, making in 24 hours one full revolution around the dial, which is divided in 2 by 12 hours. The night hours from 6 p. m. to 6 a. m. are marked by a black line. There are also on the dial two movable small needles, which mark the beginning and the end of the higher tariff. The meter is an ordinary motor meter, with two dials, one for the high and the other for the low tariff, and a relay below the dials; according as the one or the other coil is excited, this relay couples the meter to one or the other counting dial. Either relay coil is excited by the clock. When the time needle of the clock dial reaches the little needle marking the beginning of the high tariff, the night relay coil is excited. When the time needle reaches the other little needle marking the end of the high tariff, the left relay coil is excited. By setting these two needles the time of the high tariff may be determined at will. With this arrangement, therefore, there are two counters, both counting direct kilowatt-hours; but the kilowatt-hours counted by the one counter are charged for at a different rate than those counted by the other counter. The advantages of such a double tariff meter over a meter with only one dial, and in which the constants of the meter are varied at different times, are evident.—*Zeit. f. Beleucht.*, March 30.

REFERENCES.

Measuring Instruments.—HAERDEN.—A series giving illustrated descriptions of electric measuring instruments of precision. These parts deal with standard resistances, bridges of precision, instruments for measuring insulation resistance and galvanometers.—*Elek. Anz.*, April 7, 11, 14.

Magnetic Measurements.—MONTPELLIER and ALIAMET.—A continuation of their illustrated serial. In this part they describe the permeameter of Hartmann and Braun.—*L'Elec.*, April 13.

Photometry.—SHARP.—An article on the photometer equipment at Cornell University.—*Sibley Jour.*, April.

Localizing Faults.—CHARPENTIER.—An article, illustrated by diagrams, in which he describes a general method of localizing faults in a distributing network.—*L'Eclairage Elec.*, March 9.

Cable Tests.—A description of the methods used in the British Navy, for testing electric cables.—Lond. *Elec. Rev.*, April 19.

Direct-Reading Wattmeters.—ARMAGNAT.—A brief article in which he develops the formula for the error, due to mutual induction, in a direct-reading wattmeter. This error is negative and small and independent of the reactance of the circuit. It is so small that it may be neglected in practice.—*L'Eclairage Elec.*, March 23.

Motor Meters.—An article in which the principles of motor meters are explained in a general way.—*Rose Tech.*, April.

Phase Meter.—Johonnott.—An illustrated article on Rayleigh's alternating-current phase meter. The results of some tests are given in diagrams and tables.—*Rose Tech.*, April.

Telegraphy, Telephony and Signals.

REFERENCES.

Wireless Telegraphy.—Lamotte.—A very long, illustrated summary of the present status of wireless telegraphy. He starts from the experiments of Popoff and Marconi, and discusses in detail the construction and the action of both the transmitting and receiving apparatus. The article is concluded by some remarks on Slaby's system of tuning and on receivers of tubes with rarefied gases.—*L'Eclairage Elec.*, March 23.

Printing Telegraph.—Hitchcock.—An article on the applications and requirements of a printing telegraph. What is wanted is a simple practical mechanical page-printer, to work like a typewriter and which can be operated with the least possible power at a speed of more than 100 words a minute. He thinks that not much can be accomplished by new inventions in the direction of improving the purely telegraphic part.—*El'ty*, April 14.

Miscellaneous.

REFERENCES.

Carbon.—Harden.—A long illustrated article in which he gives a summary of the methods of manufacturing carbon for electrical engineering, and also of the methods of testing the carbon made for different purposes.—*Elek. Zeit.*, April 11.

Lightning Rods.—A reprint of the report of the special committee of the Electrotechnical Society, of Berlin, on the rules recommended by the committee, for constructing lightning rods. The question is also discussed in an editorial.—*Elek. Zeit.*, April 11.

Paris Exposition.—Haussegger.—Continuations of his illustrated article on the exhibits of Ganz & Co. This part deals with a three-phase mine locomotive.—*L'Ind. Elec.*, Feb. 25. This part deals with lightning arresters and the retrospective exhibition of Ganz & Co.—*L'Ind. Elec.*, March 10.

Reyval.—An illustrated description of a 215-kilovolt ampere three-phase generator, exhibited by Krizik, of Prag.—*L'Eclairage Elec.*, March 23.

Reyval.—An illustrated description of a 10-pole, 350-kw direct-current dynamo, running at 110 revolutions and giving 1500 amperes at 230 volts, exhibited by the Societe Elektrotechnische Industrie de Slikkerveer (Holland).—*L'Eclairage Elec.*, March 30.

Reyval.—An illustrated description of two 300-kw synchronous converters of the French Thomson-Houston Co.—*L'Eclairage Elec.*, April 6.

Reyval.—A long and well illustrated description of direct-current machines exhibited by Schneider & Co.—*L'Eclairage Elec.*, April 13.

Franklin.—Northrup.—The first part of an illustrated historical article on Benjamin Franklin's contributions to electrical science.—*Elec. Rev.*, March 30.

New Books.

Impianti di Illuminazione Elettrica. Quinta edizione, rifatta. Di Emilio Piazzoli (Hoepli Manual). Milan: Ulrico Hoepli. 605 pages, 263 illustrations. Price, 6.50 lire.

This little book—one of the great series of Hoepli manuals—is printed on thin paper and in fine print, being of a convenient size for a pocketbook or handbook. It appears to be very popular in Europe, and is a sort of compendium of useful knowledge for European electric lighting engineers. It treats the subject very fully, both theoretically and practically, and is well equipped with illustrations and tables. The question of cost of construction and operation is also treated at some length.

Saw-Filing and Management of Saw:. By Robert Grimshaw, M. E. New Edition, revised and enlarged. New York: Norman W. Henley & Co. 93 pages, 81 illustrations. Price $1.00.

This little volume contains a large amount of practical information about saws and their management, including filing, setting, gumming, straightening, &c., and written by one who understands his subject. The author's diction, however, is open to improvement. In fact the language of the book, which is nowhere lucid, is in some places quite obscure; and although a reader who is himself familiar with saws, can see that the author's own information is extensive, the general reader may experience some difficulty in deciphering the syntactical enigmas that occur in some parts of the book. There are numerous apparently contradictory statements in the book, which we think would be reconciled if the language were clearer.

L'Annee Electrique. Electrotheraphique et Radiographique. Par. Dr. Foreau de Courmelles. Paris: Ch. Beranger. 334 pages. Price, 3.50 francs.

This is a review of the electrical progress for the year 1900. Besides entering more particularly into the work done in electrotherapy and radiography, the general progress of the science and art has been set forth in readable form. We take it that the book is intended more for the general than for the technical reader, and as such ought to prove interesting to many who desire to keep abreast of the times in electrical work.

The Inspector and Trouble Man. By A. E. Dobbs. Reprinted from *The Telephone Magazine*. Chicago: Electrical Engineering Publishing Company. 106 pages, 67 illustrations. Price, $1.00.

Notwithstanding the perfection of modern telephonic apparatus, "troubles" will crop up and require not only intelligent forethought for their prevention, but even greater perspicacity to hunt up and remove them. Mr. Dobbs, whose experience is probably second to none in this particular branch, has here given the result of his years of training in the form of a colloquial dialogue. This method of presentation appeals to many practical men to whom the majority of books appear dry and uninteresting.

Besides treating of troubles *per se*, the author inculcates in simple terms a number of fundamental principles which every telephone inspector, lineman and exchange operator ought to know. There is scarcely any point within the whole range of telephonic operation, which is not considered in this small volume, and it can be recommended to all having practical charge of such apparatus, whether it be in the exchange or on the outside line.

The book is well illustrated, but it is a great pity that there is no table of contents or index. We trust this fault may be remedied in future editions.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 9, 10 and 11, 1901.

Association of the Edison Illuminating Companies. Next meeting, Sept. 10, 1901.

Association of Railway Telegraph Superintendents. Next meeting, Buffalo, N. Y., June 19, 20 and 21, 1901.

Canadian Electrical Association. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

Independent Telephone Association of the United States. Next meeting, Buffalo, N. Y., June 11, 12 and 13, 1901.

International Association of Municipal Electricians. Next meeting, Niagara Falls, N. Y., September, 1901.

National Electric Light Association. Next meeting, Niagara Falls, N. Y., May 21-23, 1901.

New York State Street Railway Association. Next meeting, Rochester, N. Y., September, 1901.

Northwestern Electrical Association. Next meeting, Sheboygan, Wis., last week in June, 1901.

Ohio Electric Light Association. Next meeting, Put-in-Bay, Ohio.

Old Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

Pennsylvania State Street Railway Association. Next meeting, York, Pa., Sept. 4, 1901.

Some Exhibits at the Pan-American Exposition.

In addition to the partial list of exhibits at the Pan-American Exposition published in our issue of last week, the following have come to hand:

McClure's Magazine.—A portion of *McClure's Magazine* is printed at the Pan-American Exposition on a press which is equipped with the latest electrical and mechanical devices. The press is automatically fed with an automatic throw-off switch, two-sheet de-

tector and other little devices which make it complete from start to finish. This exhibit is located in Section "S," of Electricity Building.

THE KEYSTONE ELECTRIC COMPANY, Erie Pa., makes an extensive exhibit, including two generators which supply the current for the projector display of the electric fountain in the electric tower basin. These generators are located in the court of the Machinery and Transportation Building. The direct-current machine has an output of 110 kilowatts at 125 volts, running at a speed of 260 r. p. m. and driven by a tandem compound engine built by the Ball Engine Company, Erie, Pa. The other generator is belted to a simple engine built by the Skinner Engine Company, also of Erie. It has a capacity of 120 kilowatts at 125 volts, and runs at 515 r. p. m. This generator has three bearings, each of which is provided with a wedge adjustment so designed that any bearing can be removed and replaced without the necessity of a realignment of the machine.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has an exhibit in Section "F," of Electricity Building. This exhibit contains a number of old and curious rheostats, also modern rheostats, and gives a good idea of the progress and improvement which has been made in the manufacture of these devices.

THE STANLEY ELECTRIC MANUFACTURING COMPANY'S exhibit will occupy the eastern end of Section "N" in the Electrical Building, the main entrance being on Square J. A novel feature of the exhibit will be the installation of an 80-kw S. K. C. frequency changer in operation. This machine will take two-phase current at 2250 volts, 50 cycles, on one side and deliver it on the other side at 1800-volt, three-phase, 25 p. p. s. A full description of this machine is to be found in the ELECTRICAL WORLD AND ENGINEER of April 6, 1901. The Stanley Electric Manufacturing Company will have at the Exposition grounds also in operation, located in the Exposition power house, a standard two-phase 360-kw S. K. C. inductor type generator delivering current to the Exposition Company for use on the grounds at 2400 volts, 66 cycles. Its switchboard, transformer and instrument exhibit will be very complete.

THE STANLEY INSTRUMENT COMPANY, of Great Barrington, Mass., will have an exhibit of wattmeters in Section "N," of the Electricity Building. A number of its instruments will be exhibited and opportunities will be provided for examining the performance of the instruments and the details of their construction. Among other things will be shown the vertical staff carrying the meter-driving disk suspended magnetically in the manner employed in all Stanley wattmeters, in which no mechanical bearing or support is used for the vertical disk-carrying shaft. Meters will be shown in operation as well as in parts, so that a clear idea may be obtained of the instruments in operation, etc.

A Two-Wheeled Electric Automobile.

We illustrate herewith a curious type of electric automobile, which reminds one, by its huge wheels, of the old "ordinary" bicycles upon which some of us tried to break our necks in the early days of wheeling. It also recalls the type of electric car in which the motor was placed in the hub, as in those of Mr. William Baxter, Jr., a plan for which many merits are still claimed. In this "automobile cart," as its designer, Mr. Holson, calls it, the motor is placed crosswise of the axle, with a pinion at each end of the motor shaft, these pinions driving upon opposite sides of a two-faced bevel annular gear fastened to the hub of the wheel. The field frame of the motor rests in ball bearings in the hub frame, and the wires from the battery run through the hollow axle to the motor, being entirely concealed, while the motor itself, as will be noted, is "iron clad," being completely enclosed in a malleable iron case. The motors are of 1 horse-power, capable of developing up to 4 horse-power, and are multipolar series wound. The hub casing has a diameter of 13 inches. The motors take from 15 to 23 amperes on level stretches and under normal conditions.

As will be noted, the battery is slung very low, giving a very stable equilibrium, and serving practically as a floor for the vehicle. It weighs 1200 lbs. in the automobile shown, and consists of 40 Helios-Upton cells, having a capacity of 30 amperes at a three-hour discharge rate. Mr. Holson claims to have driven his machine 45 miles on one charge, and to have attained a speed of 16 miles an hour. The vehicle weighs about 2500 lbs. when carrying two passengers.

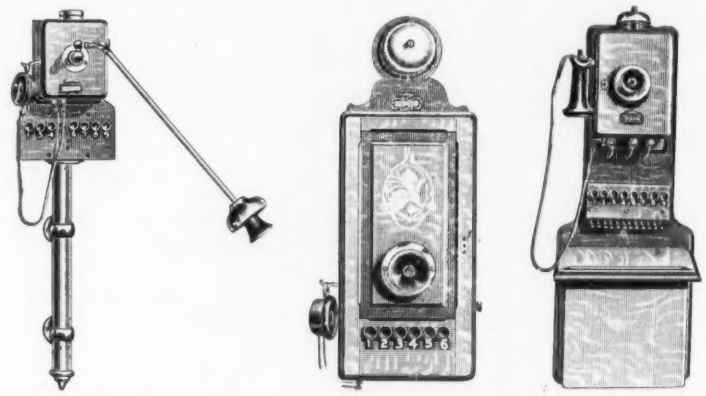
The controller used permits of four speeds. The machine is steered by a pair of mechanical brakes of the friction type, one acting on each hub, and both being operated by a leathern strap held in the hand of the driver, and functioning just as the reins do in guiding a horse. When both brakes are operated together the vehicle is brought to a standstill. The wheels have wire spokes and iron rims, and are 6 ft. 3 inches in diameter. They will take a 2-inch

AUTOMOBILE CART.

solid rubber tire in the groove, but Mr. Holson has been using two tires made of rope. When the vehicle stops an iron rod like a shaft is let down under the front platform, so that passengers can get in or dismount without its budging an inch.

Automatic Intercommunicating Telephone.

The intercommunicating telephone system of the Pacific Electric Company, La Crosse, Wis., is intended for use in factories, stores, houses, or wherever such a system could be advantageously employed. When the operator is through conversing and hangs up the receiver, the line is automatically opened, so that it is impossible for it to become "dead" through the forgetfulness of the operator



FIGS. 1, 2 AND 3.—INTERCOMMUNICATING TELEPHONES.

in leaving his plug or switch in contact. The switchboard of the system is constructed on the same principle, and is made in sizes from 10 to 200 numbers. By the use of this board the operator disconnects himself when he hangs up the receiver. Instead of a lever or plug to connect these telephones, the company uses a push button switch with a magneto device, which makes a reliable contact and permits of no failure of the automatic action of the telephone.

The accompanying illustrations represent some of the instruments of this system, Fig. 1 being an office desk telephone, Fig. 2 a house instrument and Fig. 3 a factory set. The instrument can be used with battery call system or magneto call system. The system can be connected with the central office lines.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 6 per cent nominally, and time money at 4 per cent for all dates. Mercantile paper was quiet. There was practically no demand for it in the city, but some went out of town. The rates are 4 per cent for 60 to 90 days' indorsed bills receivable, 4@4½ for choice, four to six months' single names, and 5@6 for others. The New York stock market has been, for two or three weeks past, breaking records, and last week was no exception, the transactions for the week averaging 3,000,000 shares per day. On Friday afternoon there was a reaction, which was attributed to various circumstances, but which was really brought about by the temporary exhaustion of buying power, and the desire to secure profits. The Stock Exchange at the beginning of the week was moved to the Produce Exchange, where business will be transacted until the completion of the new stock exchange building. One of the most striking features of the market during the week was the way in which one stock after another was taken hold of and advanced, one of the principal exhibitions of this kind being Union Pacific common. In the industrial list, United States Steel stocks were the leaders; in fact, they were among the most prominent shares on the market. There was free buying of a general character, both for investment and speculative account. Traction stocks participated in the early strength of the market, and favorable rumors concerning the earnings and prosperity of Brooklyn Rapid Transit had a due effect on speculation in that security. On Friday, however, came rumors of labor troubles on the system, which, although lacking confirmation, depressed the price of that stock, but only 1½ per cent. General Electric continues to maintain the firmness which has characterized this stock for several weeks past. It closed with a net gain of 2¾ points, the sales aggregating 13,000 shares. Western Union again showed strength, and the activity of this stock was a prominent feature among the electrical securities. The sales for the week amounted to 151,580 shares, the stock closing at 97, a net gain of 3½ points, the highest point reached having been 1 point within par. The tractions were weak at the close, Metropolitan having lost 3⅛ points net, and Brooklyn Rapid Transit 1¾. American District Telegraph shared in the activity among the electrics, making a net gain of 5 points, the sales aggregating 3400 shares. Trading in outside securities was rather small in volume, with price changes generally in the way of declines. Following are the closing quotations at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	Apr. 27	May 4		Apr. 27	May 4
General Electric	225	227¾	Electric Vehicle	—	10
Brooklyn Rapid Transit	85¼	83½	Electric Vehicle, pfd	—	18
Metropolitan Street Ry	172⅞	169¾	General Carriage	—	2¾
American Tel. & Cable	—	98	Illinois Elec. Veh. Tran	—	¾
Western Union Tel	93½	97	Hudson River Tel	—	120
American Dist. Tel	35	40	N. E. Elec. Veh. Tran	—	2¾
Commercial Cable	108½	185	N. Y. Elec. Veh. Tran	—	¾
Electric Boat	—	18	Tel. & Tel. Co. of Am	—	5
Electric Boat, pfd	—	45	N. Y. & N. J. Tel	—	162
Electric Lead Reduc'n	4⅝	4½			

BOSTON.

	Apr. 27	May 4		Apr. 27	May 4
New England Telephone	—	—	Erie Telephone	61	59
Mexican Telephone	3	2⅛	General Electric, pfd	—	—
Westinghouse Electric	—	—	Am. Tel. & Tel.	176	176½
Westinghouse Elec., pfd.	75½	—	Boston Electric Light	—	240

PHILADELPHIA.

	Apr. 27	May 4		Apr. 27	May 4
Electric Storage Battery	69	67	Philadelphia Electric	6½	6¼
Elec. Storage Bat., pfd.	74	74	Pa. Electric Vehicle	1⅜	1¼
Elec. Co. of America	9⅛	8½	Pa. Elec. Veh. pfd	1⅜	1
General Electric Auto	—	—	Am. Railways	44½	43½

CHICAGO.

	Apr. 27	May 4		Apr. 27	May 4
Chicago Edison	—	171	Chicago Telep. Co	—	250
Chicago City Ry	—	250	Union Traction	—	15
National Carbon	15¾	15¾	Union Traction, pfd	—	56½
National Carbon, pfd	85	85	Northwest Elev. Com	38	40

*Asked.

CONDITION OF ERIE TELEPHONE.—The report of Stone & Webster on the Erie Telephone properties summarizes as follows: Overhead construction is in accordance with good standards and well maintained. A large part of the construction has been done in past two or three years and lines as a whole are comparatively new. The underground system is in use in business sections in all of the larger cities. About 40 per cent of the total subscribers are served through underground cable, which contains 48 per cent of the total exchange wire mileage. Average amount of wire mileage underground in Bell system is 52 per cent. The Cleveland Company has 69 per cent underground; pole lines are all copper wire; 90 per cent of subscribers are using long-distance transmitters. This is unusually high. The Northwestern Company has 67 per cent of subscribers' wires underground. The Southwestern Company has 32 per cent of subscribers' wires underground. Michigan Company 43 per cent. The average age of the entire system is 2 to 3 years. The Wisconsin Company has 41 per cent of its subscribers' wires underground. Considering the Erie Company has only six cities of the 52 in the United States with population of 75,000 or more, the proportion of underground wire is very satisfactory. The Erie companies own and occupy 51 buildings and 14 parcels of land; the buildings are generally commodious and creditable. Practically all of the important towns in the territory served, are connected by toll lines, which are generally in good condition, being of standard construction. The cost to reproduce property exclusive of cost of franchises and rights of way, is placed at $26,300,000.

NEW ENGLAND ELECTRIC VEHICLE.—At a special meeting of the New England Electric Vehicle Transportation Company it was decided by a unanimous vote of 171,000 shares to cancel the contract with the Electric Vehicle Company, of New Jersey, and to dissolve the existing company. At the annual meeting the number of directors were reduced to three. The present board consists of F. R. Hart, President C. L. Edgar, both of Boston, and James E. Hayes, of Jersey City. This board will have full powers to act in winding up the affairs of the company, as authorized at the special meeting noted above. It is probable that the affairs will be in such condition within one month that a definite report can be made to the stockholders as to the probable pro rata distribution which will be made. The accident claims against the company form the most uncertain part of its liabilities. Whether the company will continue in active business for the time being has not yet been determined.

NEW ENGLAND TELEPHONE & TELEGRAPH.—The annual report of the New England Telephone & Telegraph Company for the year ended Dec. 31 compares as follows:

	1900.	1899.	Changes.
Gross	$4,518,396	$3,946,354	Inc. $572,042
Expenses	3,621,644	3,162,802	Inc. 458,842
Net	$896,752	$783,552	Inc. $113.200
Dividends	838,635	750,216	Inc. 88,419
Surplus	$58,117	$33,336	Inc. $24,781

THE UNITED GAS IMPROVEMENT COMPANY held its annual meeting last week. The report of President Dolan showed net receipts for the fiscal year ended Dec. 31, 1900, $3,386,771, which are 15 per cent on $22,500,000 stock. The profits of $4,948,923 in 1900, included premiums on certain securities realized on in the period of high security values and also certain outside operations while in the result for the year just closed they figure to a lesser degree. The net earnings compare $3,386,771 in 1900, $4,948,923 in 1899 and $1,864,129 in 1898. The directors were re-elected. Mr. Thomas Dolan was re-elected president.

TELEGRAPH & TELEPHONE.—The directors of the American Telephone & Telegraph Company state that there is no truth in the rumor that a consolidation of the Western Union, American Telephone & Telegraph Company and other companies is under consideration. If such a plan is being contemplated, the directors of the American Telephone Company have not been consulted regarding the matter. These rumors are repeated about once a month in Wall Street.

COLORADO SPRINGS ELECTRIC COMPANY BONDS.—Statistics regarding the operations of the Colorado Springs Electric Company, organized in April, 1900, to acquire the El Paso Electric Company and operate traction lines in Colorado Springs and Colorado City, Colo., are given in a circular issued by Spencer Trask & Co., offering 5 per cent 20-year gold bonds of the company. The authorized issue of these bonds is $1,000,000, of which $900,000 are outstanding.

AMERICAN STEEL & WIRE.—The following Steel & Wire directors have resigned: John W. Gates, John A. Drake, Isaac L. Ellwood, Randall Morgan, P. A. B. Widener, Thomas Dolan, Stewart H. Chisholm, Thomas F. Ryan, Philip W. Moen, James Hopkins, H. Clay Pierce. Mr. Gates also resigned as chairman. The following directors remain on the board: William Edenborn, Alfred Clifford, W. P. Palmer, Dr. L. D. Ward.

DIVIDENDS.—The directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1 per cent, payable June 1.

ROCHESTER, N. Y., TROLLEYS.—Notices have been issued of a special meeting of the stockholders of the Rochester Railway Company, to be held May 24, to consider an issue of preferred stock to the amount of $2,500,000, and for the further issue of bonds not to exceed $2,500,000, to be secured by a mortgage on the property. The company is preparing to improve its service.

THE LYNN & BOSTON STREET RAILWAY is authorized by the Massachusetts Railroad Commission to issue $2,700,000 new stock for purchase of Lowell, Lawrence & Haverhill, and $100,000 new stock for purchase of the North Woburn Street Railway, the exchange to be on a share for share basis.

AMERICAN TELEPHONE & TELEGRAPH BONDS.—Kidder, Peabody & Co. have closed subscriptions to the $2,500,000 American Telephone & Telegraph Company's collateral trust 4 per cent bonds, which have been largely oversubscribed.

Commercial Intelligence.

THE WEEK IN TRADE.—With the advent of spring weather has come a better feeling throughout trade in general. The sanguine feeling as to conditions and speculation found reflection in the enormous activity in stock speculation which attracted much money from the usual commercial channels, and expanded clearings to enormous totals. Business in general throughout the country may be described as satisfactory. The iron and steel trades continue to furnish excellent reports, although there is somewhat of a lull in the cruder forms. In the iron trade the advance of $2 per ton in rails, which went into effect on May 1, has resulted in considerable orders from railroads, 125,000 tons having been secured in Chicago alone. In finished products, consumers are still urging quick delivery, in some cases offering premiums for the same, particularly agricultural implement men. The export trade has almost stopped, temporarily, particularly in the cruder forms. The other metals are quite steady. Copper remains unchanged at the same prices that have been maintained for several months past. Lake Superior ingot is quoted at 17 cents and electrolytic at 16⅝ cents. In the machinery market the principal builders in almost every line of machines state that their shops are well filled with work, and that they are naming deliveries, which, in some instances, extend several months into the future. To a certain extent this condition of affairs is reflected along the line of the smaller manufacturers. The failures for the week, as reported by *Bradstreet's*, numbered 163, as compared with 214 the week previous and 153 the same week last year. Railway earnings continue very satisfactory, both as to gross and net receipts.

THE ALLIS-CHALMERS CONSOLIDATION was duly noted in detail in these columns last week, as effected. Vermilye & Co., the bankers, of New York, have charge of the syndicating of the property. The Board of Directors consists of Edward D. Adams, of New York; Charles Allis, of Milwaukee; Mark T. Cox, of Orange, N. J.; James H. Eckels, of Chicago; Elbert H. Gary, of New York; William A. Read, of New York, James Stillman, of New York; Edwin Reynolds, of Milwaukee; Cornelius Vanderbilt, of New York; William M. Allis, of Milwaukee; Frank G. Bigelow, of Milwaukee; W. J. Chalmers, of Chicago; William L. Elkins, Jr., of Philadelphia, and Henry W. Hoyt and Max Pam, of Chicago. It is the intention of the company to double the capacity of the Allis plant at Milwaukee by expending $2,500,000 in the erection of an addition. In the last two years the plants have earned an amount exceeding the 7 per cent required for dividend on $16,250,000 of preferred stock. There is to be $20,000,000 of common. The assets of the new company, without any consideration for the advantages accruing from the proposed consolidation, are as follows:

Cash, capital	$10,000,000
Existing plants	9,935,000
Total	$19,935,000

The valuation of the plants is made by Julian Kennedy, an expert engineer of Pittsburg. His report takes into account the real estate, buildings, machinery, tools, patterns, drawings and patents, together with cost of organizing and getting into full operation, but does not estimate the good will, and is as follows:

Allis Company	$5,120,000
Frazer & Chalmers	3,205,000
Gates Iron Works	410,000
Dickson Manufacturing Company	1,200,000

THE MONTREAL COMBINATION.—The prospectus of the Montreal Light & Power Company, just issued, shows the capital of the company to be $17,000,000. The Montreal Gas Company had put into it a capital of less than $3,000,000. It now comes into the amalgamated concern at $7,500,000. The Royal Electric Company had put into it a capital of less than $1,500,000. It now comes into the new company at $3,750,000. The Chambly Company is capitalized at $3,000,000. It is absorbed by the new concern and rounds out the seventeen-million combination. The control of Gas & Electric was secured by buying it in the open market, and the price paid represented double the original value of these stocks. Therefore, it is difficult to estimate just what the control of these companies cost the new concern. The Royal Electric Company, with shares of $100 par, has been paying dividends of 8 per cent, so its shares were worth $198 last summer and $242 latterly. The shareholders of the Gas & Electric stock, under the new apportionment, get $250 worth of new Light & Heat stock for $100 worth of the old Gas & Electric stock. The shareholders of the Chambly Company offer a majority of their stock in exchange for an equal amount of stock of the Montreal Light, Heat & Power Company. The directorate of the new concern is as follows: President, H. S. Holt; first vice-president, James Ross; second vice-president, Rodolphe Forget; secretary-treasurer, H. H. Henshaw. Directors: H. Montagu Allan, Hon. L. J. Forget, Rodolphe Forget, Lieutenant-Colonel F. C. Henshaw, H. S. Holt, Hon. Robert Mackay, C. E. Porteous, Hon. H. B. Rainville, James Ross.

THE NEW ENGLAND ELECTRIC MANUFACTURING COMPANY was organized under the laws of Massachusetts May 2, 1901, with an authorized capital of $30,000, all paid in in cash, with George O. Proctor, president; Guy H. Proctor, vice-president and manager, and Charles A. Haskell, treasurer. This company succeeds to the business of the Anchor Electric Company, with which Mr. Guy H. Proctor has been connected for five years, and will also manufacture its specialties at its factory at Somerville. Mr. Geo. O. Proctor, the president, is a prominent grain merchant of Boston. Mr. Haskell, the treasurer, has been connected with the leather trade heretofore, and was secretary of the American Hide & Leather Company, the "Upper Leather Combination." The new company start out under the most favorable auspices. Its business experience and financial standing are of the best, and it will doubtless receive its full share of patronage.

THE PACIFIC COMPANY, of Portland, Ore., has the contract for putting in a power plant at White River Falls, Ore., for the Wasco Warehouse Milling Company. The plant will contain two 500-kw A. T. B. General Electric generators, and current will be transmitted 30 miles at 22,000 volts. The Wasco Warehouse Milling Company is located at The Dalles, Ore., and owns several immense warehouses, through which pass annually millions of pounds of wool and thousands of bushels of wheat. It is constructing a large flour mill which will be operated by electric power. It also owns the electric plant at The Dalles, and will close it when the new plant is in operation. The Pacific Bridge Company is closely allied to the City & Suburban Railway, of Portland, Ore.

MANHATTAN ELEVATED CONTRACT.—The Manhattan Railway Company has closed a contract with the General Electric Company for the entire electric equipment necessary for its trains. It involves the G. E. multiple unit train control, and the motors for 800 motor cars and 400 trailer cars. Each of the motor cars has two motors, making 1600 motors in all. Six-car trains will be run. The amount involved is over $3,000,000. The Westinghouse Company secured the contracts for the power station and generating machinery involving $2,000,000. By this division of the contracts the Manhattan Railway Company is getting more expeditious service.

LARGE ELECTROLYTIC PLANT.—One of the notable recent electric contracts is the one awarded to the Stanley Electric Manufacturing Company, of Pittsfield, Mass., by the Castner Electrolytic Alkali Company, of Niagara Falls, N. Y., for eight S. K. C. motor generators, each set having a direct-current output of 500 kilowatts. These machines will take the current from the Niagara Falls Power Company at 2200 volts, 25 cycles, converting same into direct current of 245 volts for electrolytic work. The contract includes a complete switchboard equipment for handling the 8500 kilowatts.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has recently added considerably to its equipment by the purchase of new machinery, including three Gleason bevel-gear planers, which plane the teeth accurately to cone lines, and an additional automatic spur-gear cutter, and Mr. T. G. Meachem states that it is now in the market to make metal gears to order in addition to its well-known New Process noiseless pinions.

MACHADO & ROLLER, of New York City, general sales agents for the Whitney Electrical Instrument Company, have entered into an arrangement with Robert W. Blackwell & Co., Limited, whereby that well-known engineering and contracting house undertakes the sole agency for the Whitney specialties in Great Britain, France and Belgium.

THE UNITED ELECTRIC RAILWAY COMPANY, of Baltimore, has awarded a contract to the Manhattan Electrical Supply Company, of 32 Cortlandt Street, for the supply of over $50,000 worth of insulated wire of sizes varying from Nos. 00 to 14. The wire weighs about 120,000 lbs.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended April 25: Antwerp—96 packages electrical material, $7,965. Aberdeen—3 packages electrical material, $300; 13 cases electric machinery, $2,021. Argentine Republic—2 packages electrical material, $66. Brazil—208 packages electrical material, $13,316; 8 packages electric machinery, $825. British East Indies—15 cases electrical material, $500; 6 packages electric machinery, $945. British Guiana—1 package electric material, $13. Berlin—1 case electric material, $199. Brussels—2 packages electrical material, $184. British Possessions in Africa—95 packages electrical material, $7,059. British West Indies—11 packages electrical material, $136. British Australia—292 packages electrical material, $21,603; 52 cases electrical machinery, $2,053. Central America—22 cases electrical material, $663; 92 packages electrical material, $3,632. Copenhagen—10 cases electrical machinery, $462. Cuba—3 cases electrical machinery, $311; 40 cases electrical material, $1,068; 10 packages electrical material, $555. Dutch West Indies—2 packages electrical material, $32. Florence—27 packages electrical material, $5,065. Gijon—2 cases electrical material, $81. Glasgow—67 packages electrical machinery, $9,541; 11 cases electrical material, $130. Genoa—1 package electrical material, $145. Gibraltar—13 packages electrical material, $750. Hayti—1 case electrical material, $40. Havre—38 packages electrical material, $2,630. London—104 packages electrical machinery, $8,910; 161 packages electrical material, $7,464; 1 case motor vehicles, $148. Liverpool—173 packages electrical machinery, $70,-833; 151 packages electrical material, $30,972. Lisbon—2 cases electrical material, $14; 1 case telephone material, $66; 3 coils cable, $2,890. Mexico—26 cases electrical machinery, $4,171; 39 cases electrical material, $1988; 9 reels cable, $3,803. Manchester—1 package electrical material, $30; 229 cases electrical machinery, $27,645; 19 packages motor parts, $2,200. Marseilles—3 cases electrical machinery, $104; 24 cases electrical material, $800. Milan—6 cases electrical material, $3,000. New Zealand—56 packages electrical material, $3,197; 9 packages electrical machinery, $1,225. New Castle—6 cases electrical material, $500. Peru—2 cases electrical material, $30; 265 casese electrical machinery, $19,075. Preston—2 cases electrical material, $100. Southampton—1 case motor vehicles, $25; 10 packages electrical material, $319; 6 packages electrical machinery, $743. Tasmania—39 packages electrical material, $1,120. United States of Colombia—33 cases electrical material, $415. Vienna—4 packages electrical material, $343. Venezuela—52 packages electrical material, $790.

APPARATUS FOR WASHINGTON.—Though the appropriation for the installation of an electric lighting plant for the Interior Department does not become available for several months, it is noted by the Washington *Times* that the plans for the system are being developed. Congress appropriated $74,000 for the work, and that is considered to be hardly sufficient to make all the improvements which are needed in the lighting and the heating of the buildings used by the Interior Department. When the exact needs of the Department, in the line of lighting, heating and ventilation are ascertained, experts from the Treasury will be set to work upon the specifications. The scheme now includes an electric lighting plant, which will be placed somewhere in the building of the Interior Department, probably in a small house, which now stands in the court. This plant will supply current for the Interior Department, the Patent Office, the Pension Office, the old General Post Office building, and perhaps several others. The capacity of the plant will probably be about 6000 incandescent lamps, with boilers of 625 horse-power, and 500-hp engines. A new heating plant will be installed to furnish hot water for warming the Interior Department building, and steam for the Patent Office.

A REAL ISOLATED PLANT is what is proposed for the Boreel Building on Broadway, New York. The famous dingy restaurant in its rear has been bought by the Central Realty, Bond & Trust Company, which owns the Boreel Building, on the adjoining Broadway block, between Cedar and Thames Streets, soon to be replaced by a modern structure. New methods have made the basements of these skyscrapers available for so many uses that the proprietors of the new Boreel Building will not use any of the space in its basement for engines, boilers and dynamos, but will build instead a separate isolated plant on the nearby corner now occupied by "Old Tom's." It is thought that the rents of the additional space in the basement secured in this way will show the purchase of the neighboring property to be a sound business plan.

J. HOLT GATES & CO., 15 Monadnock Block, Chicago, are installing two 60-kw, 60-cycle, 1100-volt Warren alternators at 300 revolutions, direct connected to two Skinner engines, for the city of Cedarburg, Wis. The switchboard will be a fine piece of work and 10 ft. long. The dynamos will be run in parallel, and 50 arc lamps of the series-alternating system will be run in connection with the incandescent lighting. The Warren Company is making a specialty of small direct-connected alternating units for city lighting plants. The double voltage plant the Warren Company furnished to Urbana, Ill., has been a great success, and has excited much interest among electricians generally.

WORK IN CANADA.—Commercial Agent Boardman, writes from Rimouski, April 6, 1901: A company has been formed to put waterworks and an electric light plant in Rimouski. The town has voted to guarantee the interest on $50,000 of the bonds for 25 years. The company has purchased good water power and taken over the old aqueduct. Parties wishing to furnish supplies should write to Dr. G. T. Demers, secretary. Mr. A. Portugais, an enterprising plumber of this town, wishes catalogues and price lists of plumbers' and electric supplies. He does the work for the whole county and thinks he can purchase a part of his goods, if not all, cheaper in the United States.

MR. EDWARD BERGTHEIL and H. Wilson-Young, of the British electrical engineering and contracting firm of Bergtheil & Young, Camomile Street, London, E. C., are now in this country for the purpose of placing some important contracts for electrical equipment and supplies. These gentlemen have just returned from Cincinnati, where they are understood to have placed some substantial contracts with the Bullock Electric & Manufacturing Company, whose British interests they take care of. Messrs. Bergtheil and Wilson-Young are at present stopping at the Waldorf-Astoria. They will be in this country for another 10 days.

ELECTRIC PLANTS IN DUTCH EAST INDIA.—Under date of March 29, 1901, Consul Hill, of Amsterdam, informs the Department that Messrs. H. R. der Mosch and H. Jul Joostenz, of Batavia, Java, have been granted a 30-year concession for the erection of electric light and power plants in the cities of Padang and Djokjakarta. Padang, says the consul, is the largest city of the west coast of Sumatra and has a population of about 35,000. Djokjakarta contains 85,000 people and may be reached by rail from Samarang.

CONTRACT FOR RAILWAY EXTENSION.—Mr. J. Willis Fox, contractor and engineer, 32 Broadway, New York, has secured the contract for the five-mile extension of the Perth Amboy line of the Raritan Traction Company, to Metuchen and Maurer. This also includes the contract for 30,000 square yards of macadam. All material has been purchased, except the macadam stone and cinder ballast, which later will be put 6 inches under the ties.

BRITISH TONNAGE DECREASE.—The report of the British Boiler-Makers' and Shipbuilders' Society shows a decrease of 100,-000 tons in the vessels launched during the past year, as compared with 1899. "America," says the report, "has shown a decreased tonnage, and is seeking other means to secure supremacy in the shipbuilding world. The American yards are better equipped with electrical and labor-saving appliances than any in Europe."

THE LIDGERWOOD MANUFACTURING COMPANY, of New York City, which concern is adding to its already commodious offices, has secured a contract from the General Electric Company for five electric hoists to be shipped to British India, where the machines will be utilized for erecting purposes at the power transmission plant at Cauvery Falls, Mysore, for which, it will be recalled, the General Electric Company obtained the contract.

POWER IN WASHINGTON STATE.—The Washington Water Power Company, of Spokane, Wash., which is operating the electric street railway and lighting systems, is arranging to turn the mill wheels of three other counties, Lincoln, Douglass and Adams; also to light the towns of Paha, Cheney, Sprague, Rittsville, Medical Lake, Reardon, Davenport and Farrington. The present capacity, 6000 horse-power, will be increased one-half.

THE CINCINNATI PLANER COMPANY, of Cincinnati, Ohio, reports an improvement in foreign business, having recently booked orders from England, Holland, Italy, Australia, South America and Mexico. It also reports home trade as very good, especially on the larger sizes, having six 60-inch planers now in process of construction.

BIG TOOL ORDER.—The British Westinghouse Electric Company has placed with the Niles-Bement-Pond Company an order for the factory to be constructed by the Westinghouse Company in England. The contract aggregates $420,000, it is said, and is undoubtedly one of the largest for machine tools placed.

ARGENTINE ELECTRICAL IMPORTS.—The imports of electrical machinery, appliances and other supplies, including cable wire and fittings for gas and kerosene lamps, by the Argentine Republic in 1900 were valued at $1,039,531. This was a decrease of $256,918 when compared with like importations in 1899.

THE W. H. ROE COMPANY, of 97 Franklin Street, New York City, is about to construct large hosiery and knit goods works at West Huntsville, Ala., in which electricity will play an important part. C. R. Makepeace, of Providence, R. I., is acting as consulting engineer for the projected plant.

General News.

THE TELEPHONE.

ANSONIA, CONN.—The sale of the Ansonia Telephone Company to the Southern New England Telephone Company was completed in New Haven recently. The price paid for the stock was 150, payment being made in bonds of the Southern New England Telephone Company, which are now worth 123. Rates on the newly acquired circuits will be raised July 1 to the regular rates of the Southern New England Company.

BRADFORD, ILL.—The Milo & Bradford Telephone Company has been incorporated. Capital stock, $5,000. Incorporators: John McClane, Leroy H. Reed and Harmon S. Pettigrew.

CHICAGO, ILL.—The Monarch Telephone Manufacturing Company has been incorporated here. Capital stock, $10,000. Incorporators: John E. Norling, Ernest E. Yaxley and Ward B. Sawyer.

CHICAGO, ILL.—The International Telephone Manufacturing Company has been incorporated here. Capital stock, $100,000. Incorporators: William E. McCormick, J. F. Dunlap and George H. Dunlap.

DES MOINES, IOWA.—The Trans-Mississippi Telephone & Telegraph Company, with offices at Des Moines, and a capital of $100,000, has been incorporated. J. W. Hill, of Des Moines, is president.

WINTERSET, IA.—The Hawkeye Telephone Company will build a new line from Winterset to Des Moines by way of Patterson and Bevington, and possibly Indianola. The company has also secured a franchise at Greenfield and it is likely that a line will be built connecting that town with Winterset in the near future.

TAYLORSVILLE, KY.—The Taylorsville & Bethlehem Telephone Company and the Normandy & Williamsville Telephone Company, both of Spencer County, have filed articles of incorporation.

LOUISVILLE, KY.—The Home Telephone Company, recently incorporated with a capital of $500,000, is said to have received 1,600 subscribers who have signed three-year contracts, and promises to begin business when 3,000 have been secured. John Armstrong, a local capitalist, is president, and E. W. Coleman, secretary and manager.

NEWROADS, LA.—The town council of Newroads has granted a franchise to the Cumberland Telephone Company.

BOSTON, MASS.—The report of Stone & Webster places the structural value of the Erie Telephone system, exclusive of cost of franchises and rights of way, at $25,570,000.

BOSTON, MASS.—The Erie telephone system made a net gain of 1961 subscribers in April: net gain since January, 4981. Total connected April 30, 146,580; waiting connection, 3666.

BOSTON, MASS.—It is understood that the syndicate of local banking houses which purchased the $50,000,000 of American Telephone & Telegraph 4 per cent. bonds, issued early in March, has sold them around par, with 100½ bid and none offered. Negotiations for the purchase of a like amount of bonds, to be issued early in May, are in progress.

SPRINGFIELD, MASS.—A rate of $18 a year on ten-party lines has been granted by the New England Telephone & Telegraph Company to subscribers to the residence service in small towns in Western Massachusetts. Sixty party business telephones, which have been restricted to 500 calls a year, now have unlimited service at the old price, $25. The cities do not share in the reductions.

BOSTON, MASS.—The American Telephone instrument statement for the month ended April 20 shows:

	1901.	1900.	1899.	1898.
Gross output	72,396	53,190	61,481	29,254
Returned	33,177	20,077	13,079	13,139
Net output	39,219	33,113	48,402	16,125
Since Dec. 20:				
Gross output	288,505	236,193	224,325	109,921
Returned	122,604	83,121	54,804	51,697
Net output	165,901	153,072	169,521	58,224
Total outstanding	2,118,717	1,733,577	1,294,767	977,345

DETROIT, MICH.—The Bell Telephone Company will extend its Windsor line to St. Joachim, in Rochester township.

GRAND RAPIDS, MICH.—The directors of the Citizens' Telephone Company have authorized the building of several important lines for the farmers, to be connected with exchanges in Hastings, Lowell, Cedar Springs and Rockford. There will be about 60 miles of these lines. They also ordered the building of considerable extensions of the State toll lines in counties north of Grand Rapids.

DETROIT, MICH.—Arrangements have been completed for the construction of the Detroit system of the People's Telephone Company. They include the erection of an exchange building. The company has planned an extensive underground system. Work on it will begin at once, the material being furnished by the Standard Underground Cable Company, of Pittsburg. The switchboard and telephones will be made by the Stromberg-Carlson Manufacturing Company, of Chicago, and the installation date specified in the contract, which was let recently, is February 1, 1902. The switchboard which will be first installed will have a capacity for 6,000 separate lines and arrangements have been made to care for double this number as the business of the company increases. It will cost $125,000, and with the 6,000 telephones ordered the contract amounted in all to $203,000. The contracts for poles, wire, and other materials have not yet been awarded.

ST. PAUL, MINN.—The Twin City Telephone Company has planned to make a general extension of its system to the residence districts of the city during the present season.

DULUTH, MINN.—The Zenith Telephone Company of Duluth will increase its funds by an issue of $100,000 in bonds, which will be used for extensions.

ELBOW LAKE, MINN.—The Elbow Lake Telephone Company has been incorporated. Capital stock, $10,000. Incorporators: Henry Sampson, Edward J. Scofield, Testen E. Dybdall, L. V. Barnes, William E. Lundeene, all of Elbow Lake.

HAY SPRINGS, NEB.—The Hay Springs Telephone Company has been organized to construct and operate a telephone to Moomon, a distance of twenty miles south of this place, then to connect with the Pine Creek Company's line, extending into the heart of the Sand Hills cattle country. W. B. McQuinn was elected president. The secretary was instructed to procure estimates for material and for construction of the line.

NEW LISBON, N. J.—The Union Telephone Company has been incorporated. Capital, $3,000. Incorporators: Wm. H. Reeves, Alfred J. Davis, M. Warner Hargrove.

SALAMANCA, N. Y.—Irving Hall is building a telephone line from East Randolph to Steamburg and Tunessassa. He will connect with the Independent Telephone line at Salamanca, and get connections with Red House and Little Valley.

ALBANY, N. Y.—The Albany Home Telephone Company, capital $750,000, has been incorporated. Directors: Samuel B. Rawson, F. H. Sudro, T. M. Brush, F. W. Martin, I. H. Griswold, A. E. Lord, of Elyria, Ohio; G. C. Lee, Jr., Howard Hendrickson, W. H. Keller of Albany.

LONDON, OHIO.—The Madison-Clark Telephone Company, has been incorporated. Capital stock, $75,000.

CINCINNATI, OHIO.—The Spencerville Telephone Company, Spencerville, Ohio, has been incorporated. The capital stock is $20,000.

COLUMBUS, OHIO.—The Port Clinton Telephone Company has been incorporated, with a capital of $40,000 by James H. Brailey, Jr., Ed. L. Barber, Fred J. Bollmeyer, H. A. Barber and J. C. King.

COLUMBUS, OHIO.—At the call of President Yates of the State Association, just half of Ohio's County Auditors met in this city a few days ago to discuss questions of increasing valuations, among which came up the matter of telephone boxes. It was agreed to fix a minimum valuation of $10 a box.

CINCINNATI, OHIO.—President John A. Church, of the Business Men's Club of Cincinnati, has appointed a committee of five, whose duty it will be to take up complaints of various business men from cities and towns outside Cincinnati who allege that they can not secure equitable treatment at the hands of the Cincinnati Telephone Company.

JACKSON, OHIO.—Ira A. Sternberger, of this city, says that a representative of the new telephone line to be built between Jackson, Wellston and Colton, toward Waverly, Ohio., is in the East purchasing equipment. Connection will be made at Beavetown, Ohio, with the United States Independent Telephone lines, which will give entrance into Portsmouth, Toledo, Cleveland, Columbus and all the principal cities of the State except Cincinnati.

OTTAWA, ONT.—The Committee on Banking and Commerce of the Dominion Senate has reported the bill increasing the capital stock of the Bell Telephone Company from $5,000,000 to $10,000,000. The company has thus won out against all opposition. The proposal to restrict the rates the company may charge to such rates as were in existence in 1892, when the company got its original increase of capital stock, and the proposal also of making the company liable for any over-charges since that time, were rejected. The company, however, accepted part of the amendment compelling it to furnish telephones upon application from persons living adjacent to the telephone system. The company was ordered to produce a list of its shareholders before the bill was further proceeded with.

PORTLAND, OREGON.—It is reported that the Columbia Telephone Company, of Portland, which has maintained for several years a large independent system, will be bought out by Ohio capitalists. It is said that the same persons—from Warren and Youngstown, Ohio—who have installed independent telephone systems in Seattle, Wash., and Birmingham, Ala., will organize a $500,000 company to purchase and operate the Portland system.

MARSHFIELD, S. D.—The telephone line between Neillsville and Chili will at once be extended to Marshfield.

PIERRE, S. D.—Articles of incorporation have been filed for the Universal Wireless Telegraph Company, with a capital of $20,000,000. The incorporators are James N. Huston, Thomas E. Bishop and L. C. Smith.

ABERDEEN, S. D.—Manager Zeitlon, of the Dakota Central Telephone Company, has returned from the East, where he arranged for the purchase of large quantities of wire, poles and other supplies for the extension of the system. Copper wire for a new metallic circuit between Aberdeen and the twin cities will soon arrive and the line will be completed as soon as possible. It is possible a branch line from this circuit may be run into Watertown. New exchanges will be put in at Britton, Wilmot and Bryant.

COOKEVILLE, TENN.—The stockholders of the Overton Telephone Company have completed the reorganization of the company. The capital stock was increased from $5,000 to $25,000.

NASHVILLE, TENN.—A charter has been issued to the People's Telephone Company, of Stewart County. The capital stock is $3,000. The incorporators are W. T. Thomas, R. G. McFall, W. B. Scott, C. C. Lewis, W. O. Edwards, George Stacker and R. E. Thomas.

DALLAS, TEXAS.—The Trans-Texas Telephone Company, with headquarters in Brenham, will extend its line north from Caldwell to Milano.

FULDA, TEX.—The Bellah Telephone Company, of Fulda, Baylor County, capital stock $2100, has been incorporated by Sam Bellah, Sidney Webb and W. F. Kaufman.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will build a toll line from Merrill to Rhinelander via Tomahawk.

ELECTRIC LIGHT AND POWER.

VANCOUVER, B. C.—The city council of Vancouver, B. C., has granted an eighteen years' franchise to the Stave Lake Power Company to supply light and power within the city.

SAN FRANCISCO, CALIF.—Electric power generated on the Yuba River 140 miles distant, was for the first time used in the operation of street cars in Oakland on April 28. This is said to be the longest transmission line in the world. The current is transmitted at 40,000 volts.

SAN FRANCISCO, CALIF.—The hoisting at the leading mines on the Comstock Lode, Virginia City, Nev., will soon be done by electricity. The electric hoist at the Yellow Jacket shaft is completed and ready for operation. The electric hoisting machinery for the C. & C. and the Union shafts has been finished at the Risdon Iron Works, San Francisco, and will soon be installed. The next electric plant to be started up will be the one at the Belcher shaft.

DAHLONEGA, GA.—A. J. Warner and W. A. Carlisle, of Marietta, Ohio, and J. F. Moore have incorporated the North Georgia Electric Company, with a capital stock of $50,000.

ATLANTA, GA.—Mayor Mims has approved an ordinance granting a franchise to the Atlanta Railway & Power Company to operate an electric lighting plant in this city, thus almost assuring competition in electric lighting.

MURPHYSBORO, ILL.—An electric-haulage plant is being placed in position at the Harrison coal mine by the Big Muddy Coal & Iron Company. The change is an innovation in mining methods in this section, and the result will be watched with interest.

CAMBRIDGE CITY, IND.—A new municipal electric light plant has been installed in this city. The original cost was $14,000.

HARTFORD, KY.—The Hartford & Beaver Dam Electric Light, Railway & Power Company, of Hartford, Ky., with a capital stock of $50,000, has filed articles of incorporation.

COVINGTON, KY.—The formal transfer whereby various independent organizations are merged into the Union Light, Heat & Power Company, of Covington, has just been effected. The new company owns and controls all the plants in every Kentucky city opposite Cincinnati for several miles in either direction.

CITY OF MEXICO, MEX.—The new electric light plant of Victoria, State of Tamaulipas, Mexico, has been successfully inaugurated.

CITY OF MEXICO, MEX.—Among the important municipal improvements now under way in the city of Merida, the capital of Yucatan, Mexico, is the installation of electric light and gas systems.

MINNEAPOLIS, MINN.—The Barnett & Record Company has recently contracted to build a fireproof grain elevator with a capacity of 1,650,000 bushels for the St. Anthony Elevator Company, of Minneapolis. The elevator receiving machinery, scales, etc., will be operated by electric motors. A new power house will probably be built to furnish the current.

ST. PAUL, MINN.—Articles of incorporation for the St. Louis River Power & Improvement Company have been filed with the Secretary of State. The capital stock is fixed at $100,000. The principal place for conducting business is Cloquet, where a series of river improvements will be made by which the company will be enabled to supply electric, lighting and power. The incorporators are R. M. and F. E. Weyerhauser and Frank B. Poole, of Cloquet; William Irvine, of Chippewa Falls, Wis., and F. C. Denckman, of Rock Island, Ill.

CLINTON, MO.—The Clinton Light & Water Company, with a capital stock of $180,000, has been incorporated by James M. Avery, Paul Tyler, J. T. March and others as incorporators.

HELENA, MONT.—The Missouri River Power Company, which owns a dam and power plant at Canyon Ferry, and which is now constructing a pole line to Butte, will build another dam across the Missouri River at Stubbs' Ferry, five miles below the plant now in operation. The new dam and plant will cost about $1,000,000, and will develop 10,000 horse-power, which, with part of the power now generated at Canyon Ferry, will be sent to Butte.

ALBANY, N. Y.—Lake Placid Electric Light Company has been incorporated. Capital, $10,000. Directors: Melville Dewey, Annie Dewey, Asa O. Gallup, of New York City.

ALBANY, N. Y.—The Carthage Electric Light & Power Company, of Carthage, has been incorporated. Capital, $75,000. Directors: J. E. Strickland and P. J. Corcoran, Carthage; T. B. Basselin, Croghan.

CORNING, N. Y.—The Corning Gas Company has sold its illuminating gas plant and the Corning Likht & Power Company, the city electric lighting plant, to a syndicate of Eastern capitalists headed by Alden M. Young of New York city.

BUTLER, OHIO.—The village authorities have decided to build a municipal lighting plant and are inspecting plants in surrounding cities with a view to securing figures.

KENTON, OHIO.—Samuel R. Bullock, of New York, has purchased the plant of the Kenton Gas & Electric Company. The plant will be enlarged to furnish power for the new road.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Light Company has just put into service two boilers of 1500-hp each and a new engine, together with generators of a capacity of 30,000 lights. This equipment is additional to that already in service.

COLUMBUS, OHIO.—The city council passed April 29 the ordinance providing for the issuance of $110,000 bonds for the erection of a new municipal light plant. The bonds are to bear 4 per cent. interest and to run thirty years with privilege of redemption in ten years.

OTTAWA, ONT.—The Metropolitan Power Company, at Britannia, near Ottawa, has had a large force of men at work all winter, and the gigantic power canal is well on toward completion. Before this canal can be cut through to the river, however, an immense coffer dam will have to be constructed to hold the river water back while the work of rock cutting is pushed ahead; work on the big power house will be commenced at once. It is expected that water will be let into the canal in September next. At present the rock is being removed at the rate of about 250 carloads per day. Timber is being placed in position for the construction of the permanent coffer dam, and concrete will be manufactured for the piers and power houses.

GREENSBURG, PA.—C. S. Knight, of Fort Wayne, Ind., is here making plans for the erection of a mammoth electrical plant to cost $500,000. It is the intention of the company to light all of the towns within a radius of forty miles with electric lights.

MONTREAL, QUE.—The new Montreal Light & Power Company is adding to the generator capacity at Chambly power house. The additions are to be Westinghouse apparatus, and the voltage now will be stepped up to 20,000. This doubling up of voltage will, of course, give the company greater carrying capacity on its lines, and it is evident that it intends selling electricity on an extended scale. It also shows that its present plant is well loaded up.

HARRISBURG, VA.—The town council has taken steps toward establishing an electric light and power plant at a cost of $20,000.

RICHMOND, VA.—The new electrical committee of Richmond has appointed a sub-committee to frame an ordinance for the regulation of electric wires.

KILBOURN, WIS.—There is talk of building a dam on the Wisconsin River at this place and utilizing the estimated 7000-hp for developing electrical energy, to be transmitted to the various factories and to Madison, Baraboo and surrounding towns.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The San Francisco supervisors have expressed their intention of forcing the street car companies to pay an annual license tax of $50 on each car. The license is at present $15 per annum.

CANADIAN ELECTRIC RAILWAYS.—From returns received from the thirty-five electric railways of Canada, the Dominion Statistician makes up the following statement: At the end of December, 1900, the number of miles of electric railway in Canada increased 681 miles, or 49 miles over the number in the year previous. These railways carried 118,129,862 passengers in 1900, an increase of 14,097,203. This is equal to carrying the total population of the country 21 times. The car mileage run was 30,924,355 miles, an increase of 1,277,508 miles over last year. The mileage run and the passengers carried show that for each mile run the electrics carried 3.8 passengers, against 3.5 in 1899. The amount of paid-up capital invested in electrics on December 31, 1900, was $20,633,000, and the bonded debt was $12,619,422. The number of cars in active service in 1900 was 1,642, an increase of 98 over the previous year. The employes numbered 4,493, showing an increase of 164 over 1899. The total receipts for the year were $5,422,540, and the expenses were $3,268,001. Since 1897, the number of passengers carried by the electric railways increased from 83,811,000 to 118,130,000, an increase of about 41 per cent.

NEW HAVEN, CONN.—President Hall, of the New York, New Haven & Hartford Railroad Company, denies that his company has made plans for introducing electric power on the Waterbury, Meriden & Cromwell steam road.

ATTICA, IND.—The Commissioners of Fountain county have granted a franchise to the Crawfordsville Traction Company.

EVANSVILLE, IND.—The Evansville Electric Railway Company has increased its capital stock from $50,000 to $600,000.

SHELBYVILLE, IND.—At a meeting held by the local electric company recently the estimate for the construction and equipment of the electric railroad between this city and Indianapolis was ratified. Contracts for the construction will be let as soon as preliminaries can be arranged. This action insures the building of this important line. Ed. K. Adams is president of the company.

BALTIMORE, MD.—It is understood in financial circles here that plans are well advanced for the formation of a large security holding company which will make a specialty of controlling, operating and constructing railroads in various cities. Messrs. Middendorf, Oliver & Company, of Baltimore, are among the financiers associated with the company, which has a total authorized capital of $5,000,000. It is understood from an authoritative source that the enterprise will be broad in character and that offices will be opened in Baltimore, New York and other leading cities.

TRENTON, N. J.—The Paulsboro Traction Company has been incorporated. Capital, $1,000,000. The incorporators are Benjamin C. Paul, George C. Laws and George S. Talman.

TRENTON, N. J.—Al Johnson, of New York, the projector of the scheme to connect New York and Philadelphia by trolley, has obtained control of the Trenton, Lawrenceville & Princeton Railroad Company and the Princeton extension. The new company was organized by the election of the following directors: Al Johnson, New York, president; C. M. Bates, New York, secretary and treasurer; Wilbur F. Sadler, Jr., Trenton; F. S. Drake, Philadelphia; W. C. Callahan, Trenton.

NEW YORK, N. Y.—The Brooklyn Car Company, of Brooklyn, has been incorporated. Capital, $3,000. Directors: G. T. Andrews, Brooklyn; F. H. Quinby and H. M. Jackson, New York City.

YOUNGSTOWN, OHIO.—The Ohio River & Youngstown Railway Company has been incorporated by Walter S. Snyder, Albert Fassig, John Patterson, George E. Long and Will E. Nye. Temporary capital stock, $10,000.

ALLIANCE, OHIO.—The Coraopolis & Monaca Electric Railway Company has been incorporated by Henry Cooper, Bellevue; J. C. Whitla, H. T. Dempsey, Beaver Falls; Hermann W. Klein, Allegheny, and C. I. McDonald, Pittsburg.

CLEVELAND, OHIO.—The Cleveland & Chagrin Falls Railway Company has placed a contract for the erection and equipment of a storage battery power

station to assist in the operation of the Garrettsville and Warren extensions of the line.

CINCINNATI, OHIO.—The Cincinnati, Dayton & Maysville Traction Company has been incorporated with $10,000 capital stock, which will be increased in the near future to $1,000,000. E. D. Smith, of Blanchester, has been elected president.

COLUMBUS, OHIO.—Officers for the Columbus, Delaware & Northern Railway Company have been elected as follows: James Loren, Columbus, president; J. W. Webb, Springfield, vice-president and treasurer; H. A. Fisher, Columbus, general manager; Lee Fisher, Columbus, chief engineer.

CLEVELAND, OHIO.—The stockholders of the Cleveland, Painesville & Eastern Railway Company have ratified the decision of the directors to extend the line from Painesville to Ashtabula with a branch line to Fairport and voted to increase the capital stock from $1,500,000 to $2,000,000.

YOUNGSTOWN, OHIO.—The Sharon & State Line Electric Railway Company has been incorporated under the laws of Pennsylvania by the Penhale-Devitt syndicate. Capital stock, $10,000. The company will operate the Pennsylvania section of the Youngstown & Sharon Electric Railway.

CLEVELAND, OHIO.—An Eastern syndicate is reported to have taken an option on the car manufacturing business of G. C. Kuhlman, of Cleveland. Mr. Kuhlman also has a proposition before the Chamber of Commerce of Elyria, Ohio, for the erection of a plant in that city, in case the Eastern deal is not closed. Mr. Kuhlman proposes to organize a company with $250,000 capital stock.

CANTON, OHIO.—The promoters of the Canton-Akron Electric Railway have organized by electing the following officers: W. H. Hoover, president; Aaron Wagoner, vice-president; Charles A. Kolp, secretary; P. L. Saltonstall, treasurer, and John C. Welty, general counsel. Directors: Wm. H. Hoover, New Berlin; P. L. Saltonstall and C. Eldridge, Boston, Mass.; L. E. Meyers, Chicago; Charles A. Kolp, A. C. Brant and John C. Welty, Canton, and George Crouse and Aaron Wagoner, Akron. A contract for the construction of the road has been placed with L. E. Myers & Company, Chicago.

YOUNGSTOWN, OHIO.—The Penhale-Devitt syndicate, which controls a number of important lighting and railway properties in this vicinity, has secured an agreement with Richard Quay, chief owner of the New Castle Traction Company, the Beaver Falls road, and the connecting links between New Castle and Pittsburg for the consolidation of the two interests. Under the terms of the new consolidation, only one line is to be built between Sharon and New Castle, and the Sharon & New Castle Electric Railway Company has been organized with the following officers: Directors, R. R. Quay, George F. Penhale, M. A. Devitt, H. W. Whipple, M. A. Norris, Alexander McDowell and William Wallace. W. H. Whipple was elected president and M. A. Norris, secretary. By this consolidation it is stated the syndicate controls completed and projected roads making through lines from Youngstown to Pittsburg, and from Pittsburg to Erie.

PITTSBURG, PA.—A charter has been granted to the Coraopolis & Monaca Electric Railway Company for the construction of a line between the points named. The incorporators are: Henry Cooper, Bellevue; J. C. Whitla, Beaver Falls; H. T. Dempsey, Beaver Falls; Herman W. Klein, Allegheny, and C. I. McDonald, of Pittsburg.

CHATTANOOGA, TENN.—Clarence P. King and J. H. Jeffries, Philadelphia capitalists, are here to close a deal for the purchase of the incline up Lookout Mountain, which will be operated in connection with a rapid transit system in which they are interested. They are also negotiating for the purchase of the Chattanooga Electric Railway. If they succeed they will control the entire electric railway system of the city and a line to Chickamauga Park 150 miles in length. The deal would involve $1,000,000.

DAVILLA, TEX.—Mr. E. C. Sonntag, general manager of the Davilla Telephone & Improvement Company, is interested in a plan for the building of an electric railway from Bartlett to this place, a distance of ten miles. Mr. Sonntag believes that the investment will be a paying one and would like to correspond with capitalists in regard to the project.

SHEBOYGAN, WIS.—It is announced that an electric railway will be built from this city to Manitowoc.

MILWAUKEE, WIS.—The Wisconsin Traction, Heat & Power Company has taken important steps to complete the system of electric railways in the Fox River Valley. The acquiring of the property of the Appleton Electric Light & Power Company and the Fox River Valley Electric Railway Company has been commenced and consolidation of the two properties is contemplated. The company has secured a 99-year lease from the Green Bay & Mississippi Canal Company, of the water power and the site of the old Atlas pulp mill at Appleton, and will use the water power to supply electrical energy to Appleton and vicinity.

THE AUTOMOBILE.

SAN FRANCISCO, CALIF.—The San Francisco Fire Commissioners recently decided to order an automobile for the use of Chief Sullivan, and he will soon be able to dispense with horseflesh in going to fires.

ST. LOUIS, MO.—Notice of an increase in its capital stock from $30,000 to $50,000 has been filed by the Scott Automobile Company, all of the increase being paid up. The firm claims assets of $50,000, with no liabilities.

A FAST RUN.—The Automobile Club of America had a fast run on April 27 from College Point, Long Island, to Oyster Bay and back. On the return trip Mr. H. Ward Leonard made twenty-three miles in 55 minutes from Jericho.

THE CHICAGO AUTOMOBILE CLUB held a club run to Wheeling and return Sunday, April 28. Sixteen members made the round. It was the most successful run yet made by the club and showed that the weak points on many of the vehicles which caused annoying delays on previous runs had been overcome.

ELECTION.—At the annual meeting of the General Carriage Company, held in Camden, N. J., last week the retiring board of directors was re-elected, with the exception of T. L. Bragaw, Jr., who was succeeded by John J. Treacy. The directors will meet for organization in a few days, and it is expected that only slight changes will be made in the officers.

LEGAL.

GETTING OFF CARS.—The duty of passengers to look out for themselves in alighting from street cars is stated by the Massachusetts Supreme Court in an action for damages brought by Mrs. Oddy and her husband against a street car company. She intended to leave the car at Lansing Street, Roxbury, but just before that street was reached a fire engine and a hose carriage came along, and the car stopped, according to the rules of the company. Mrs. Oddy, thinking the car had stopped for her, left the car and was knocked down, and injured by the hose carriage. She and her husband sued for damages. A verdict for the company was affirmed by the Supreme Court on the ground that the company had not been negligent. The duties of the conductor were defined by the judge as follows: "It was right for the motorman to stop the car where he did upon the approach of the fire apparatus. The conductor, while bound to give the passenger an opportunity to leave at the stopping-place which had been indicated to him as the point where she wished her journey to end, was not obliged to inform her that that place had not been reached, unless he knew that she was attempting to leave under a misapprehension, and it was his duty to attend to the very things to which he was attending, namely, ascertaining when the obstruction to the progress of the car should cease by the passing of the approaching fire apparatus." The duties of passengers were stated by the court as follows: "Street car companies carrying passengers in ordinary public streets or highways are not negligent in not providing means for warning passengers about to leave a car of the danger of colliding with or being run over by other vehicles in the street. The risk of being hurt by such vehicles is the risk of the passenger, and not of the carrier. It is not a danger against which the carrier is bound to protect the passenger or to give him warning."

PERSONAL.

MR. HORATIO A. FOSTER, the electrical engineer, has removed his offices in Philadelphia to 650 Bullitt Building.

MR. F. P. FISH has been elected a director of the New England Telephone Company, to fill the vacancy caused by the death of Mr. J. E. Hudson.

MR. CHAS. J. GOLDMARK, consulting electrical and mechanical engineer, has removed his offices to the first floor, 66 and 68 New Street, New York.

MR. FRANK J. SPRAGUE left for Europe last week, several important technical matters awaiting his attention in England and on the Continent.

MR. HARRY ROLFE, of the International Correspondence Schools, Scranton, Pa., has accepted an important position in the mechanical engineering department of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.

MR. PHILIP DEXTER, of Boston, vice-president of the Erie Telephone Company, with special charge of its finances, has been visiting the field and studying up the situation in Michigan, where a large sum of money is to be spent.

MR. W. F. WHITE, general manager of the Cincinnati Edison Electric Company, has been made a director of the Fall Festival Association of that city, and will take an active interest in the preparations for the Festival Association parades next September.

MESSRS. EDWARD BERGTHEIL AND H. WILSON YOUNG, electrical engineers and contractors, of London, England, are being entertained in Cincinnati by the Bullock Electric Manufacturing Company. They are placing large orders for electrical supplies and equipment.

MR. C. M. JARVIS.—Owing to the determination of the United States Steel Company to concentrate all operating departments of the constituent plants at Pittsburg, Mr. Charles M. Jarvis, vice-president in charge of the operating department of the American Bridge Company has resigned, as he does not care to change his residence from New England.

MR. GEO. H. DANIELS, general passenger agent of the New York Central Railroad, has sent us an unused two-cent postage stamp. Under ordinary circumstances this would be a queer present, but it happens that the stamp is one of the Pan-American Exposition series, and bears on it a beautiful representation of the Empire State Express. Mr. Daniels informs us that probably 300,000,000 of these will be issued.

MR. G. U. G. HOLMAN, a well known electrical engineer, and late of the switchboard engineering department of the General Electric Company, has received the appointment of general manager of the Canadian Electric Light Company of Quebec and Levis, P. Q. The plant is at Chaudiere Falls, seven miles above Quebec, and the other side of the St. Lawrence. Mr. Holman will have his headquarters at Quebec May 15.

MR. A. C. BOSTWICK, the well known automobilist, tried hard to get arrested in Central Park, New York, last week for violation of the rules which compel a chauffeur to slow down to three and a half miles every time he meets a skittish horse. But it would appear that the rules are too absurd to be enforced. Mr. Bostwick was supported by Messrs. Shattuck, Chamberlin and other members of the Automobile Club of America.

MR. LOUIS GLASS, the General Manager of the Pacific States Telephone & Telegraph Company, San Francisco, will have the entire control of the company's business on the Coast, during the absence of President John I. Sabin, who will hereafter spend much of his time in Chicago as president of the Chicago Telephone Company. During the fifteen years of his connection with the telephone company, Mr. Glass has won the regard of all by his uniform courtesy towards both the public and employees. So, it is to be expected that under this arrangement very cordial relations will prevail between the people of the Pacific Coast and the management of the great Pacific system.

MR. ANDREW CARNEGIE, the whilom telegraph messenger boy, elicits the following from the New York *Tribune:* "On the cloudcapped towers of Skibo Castle Andrew Carnegie may be watching from afar the sky kissing flights of the quotations for the securities of the billion dollar steel combination which brought to him one of the largest fortunes of this generation. But for Mr. Carnegie's genius and grasp of affairs no such wonderful development of Amer-

ican steel industries would have been achieved in this era. He may well contemplate with pleasure the complete fruition of his highest hopes. He was the greatest of American makers of steel, and American steel is now at the top in both hemispheres.

YERKES MEN IN ENGLAND.—A special cable dispatch from London of May 4 says: "A strange fatality appears to surround the Yerkes Hampstead & Charing Cross underground line. One after another the lieutenants in charge of the undertaking have resigned for no apparent reason. First Mr. Louderback, who had been Mr. Yerkes' right hand man for years, discovered that the London climate was unsuitable. Then Mr. Davis, who engineered the deal originally, suddenly severed his connection and returned to New York. Yesterday Mr. Howard Abel, who was specially brought from Chicago to superintend the work, resigned too, but declined to make public his reason. He will await the arrival of Mr. Yerkes next month before returning to America. This leaves only Mr. Chapman, the engineer, to look after affairs."

MR. WALTER M. McFARLAND, acting vice-president of the Westinghouse Electric & Manufacturing Company, is the subject of an appreciative article in the May number of *Cassier's*, from the pen of Rear Admiral Geo. W. Melville, U. S. Navy. Lieut. McFarland was for a number of years private secretary and confidential assistant of the engineer-in-chief of the navy, who refers to his resignation from the service in the following terms: "While I cannot but congratulate my good friend, George Westinghouse—whose name is a synonym for engineering genius and business enterprise—on Mr. McFarland's entrance into his official corps, I cannot but regret the loss to the fleet of one of its brightest men, and to myself of a most talented and loyal assistant." The article gives an account of Lieut. McFarland's naval professional career, and concludes as follows: "McFarland, as a worker, is of essentially a healthy type—buoyant, vigorous, and inspiring. He has, in marked degree, a faculty which is essential to men of affairs—the power to preserve continuity of thought on any subject, under frequent interruption and deflection. While quick in decision and action, his judgment is exceptionally well-balanced and unerring. In closing this brief record, I can say only that I have written it with keen pleasure, in my pride in, and warm regard for, one of the ablest and most winning men with whom it has been my fortune to be associated."

OBITUARY.

FRANK STEVENS, chief operator of the Western Union Telegraph Company in Boston, died at his home in Chelsea on April 28. He was born near Concord, N. H., in 1843.

MR. FRANZ RUMMEL, the celebrated Anglo-German pianist and son-in-law of Prof. S. F. B. Morse, has just died in Germany. While touring in this country he met and married the beautiful daughter of Morse, Leila, with whom social gossip once associated the name of Governor Samuel J. Tilden. As an interpreter of Beethoven and Schumann, Prof. Rummel had no superior. He was well known in America, and greatly liked. He leaves a widow and three sons.

EDUCATIONAL.

SYRACUSE UNIVERSITY.—A catalogue of the Syracuse University for 1901 has been received. This university gives a course in electrical and mechanical engineering in charge of Prof. Graham.

THE UNIVERSITY OF TENNESSEE, Knoxville, Tenn., is establishing a system of traveling libraries, and desires to form some technical libraries which may be placed in leading shops throughout the State, remaining six months at each place. Contributions in books are solicited.

UNIVERSITY OF MINNESOTA.—The State Legislature of Minnesota has passed a bill appropriating $60,000 for new buildings and equipment for the Engineering College of the University of Minnesota. The present shop building will be enlarged and a second wing constructed to house the electrical laboratory and lighting and power plant.

PURDUE UNIVERSITY.—We have received a copy of the annual catalogue from Purdue University with the announcements for 1901-1902. Among the special lecturers on technical subjects are the following-named well known gentlemen: A. V. Abbott, of Chicago; B. J. Arnold, Chicago; C. W. Rice, New York City; E. P. Roberts, Cleveland, Ohio; Chas. F. Scott, Pittsburg; A. J. Wurts, Pittsburg; Samuel Insull, Chicago; A. E. Kennelly, Philadelphia, and S. G. McMeen, Chicago. The University has also issued a separate catalogue containing selected views of Purdue University. The issue of views of this sort is a good idea, as it gives a great deal more understandable information regarding the University than usually can be derived from cold type.

Trade Notes.

THE NEW YORK OFFICE of the Onondaga Dynamo Company, of Syracuse, N. Y., was removed on May 1 to the St. Paul Building, 220 Broadway.

OIL FILTERS FOR ENGLAND.—The British Government has just sent its third order to the Burt Manufacturing Company, of Akron, Ohio, for Cross oil filters.

MR. GEORGE BENDER, dealer in second-hand electrical machinery has removed from 153 to 137 Centre Street, New York, where he has larger quarters.

GOOD TIMES are here, or the A. B. arc lamp is becoming widely known, so says the Electric Appliance Company, Chicago, which is shipping them out by tens and hundreds.

POWER PRESSES.—"Bliss" straight-sided power presses are illustrated and briefly described in a 24-page pamphlet just issued by the E. W. Bliss Company, Brooklyn Borough, New York.

THE AMERICAN BRIDGE COMPANY will furnish to the Illinois Central Railroad Company all of the bridge work required on this railway during 1901. About 3,000 tons of steel will be used.

FARR BULLETIN.—The Farr Telephone & Construction Supply Company, of Chicago, in its April bulletin, gives many illustrations of its line of telephone apparatus, switchboards, etc. The bulletin comes in the form of a large sheet.

THE AMERICAN TOOL WORKS COMPANY, of Cincinnati, Ohio, has a contract for $18,000 worth of tools, including planers, for the Brooklyn Navy Yard. This company has received many orders of late from the Government.

FALCON KNIFE SWITCHES.—The Falcon Electric Manufacturing Company, 432 East Seventy-first Street, New York, has just issued Card No. 112 illustrating its lugs for Falcon knife switches. A price list of the devices is also given.

THE CHICAGO ARMATURE COMPANY announces the removal of its office and works to its new plant at Blue Island, Ill. The company has thus enlarged and improved its facilities so that it can handle its rapidly increasing business expeditiously.

VICKERS, SONS & MAXIM, the largest manufacturers in the world of war material, who have immense works in England and supply all the foreign governments, have recently equipped their plant with Cross oil filters, manufactured by the Burt Manufacturing Company, of Akron, Ohio.

ELECTRIC WELDING.—Two catalogues, Nos. 3 and 4, issued by the Standard Welding Company, Cleveland, Ohio, give illustrations of metal pieces and forms which are electrically welded by this company's process. One of the catalogues relates to the welding of seamless steel tube bicycle parts, and the other to automobile parts.

MACHINE TOOLS FOR ENGLAND.—It is reported that the Niles-Bement-Pond Company has secured the big Westinghouse Electric Company's contract for machines to be shipped to England. The Niles Tool Company's plant at Hamilton will furnish the major portion of the material for the British Westinghouse plant.

"A FEW INSTALLATIONS" made by the Ball Engine Company, Erie, Pa., is the title of a handsomely illustrated pamphlet recently brought out by that company. The catalogue is devoted entirely to illustrations showing installations of Ball engines in electrical plants in different parts of the country, there being no descriptive matter.

THE PERU ELECTRIC MANUFACTURING COMPANY has just issued a series of six little booklets on various articles which it manufactures. The latest is one on a porcelain handle and porcelain cross bar baby knife switch that is approved by the National Board of Underwriters. They are sent upon application free of expense.

FUSE ROSETTES are the subject of a 16-page pamphlet of the Peru Electric Manufacturing Company, Peru, Ind. These rosettes are made in several designs and are adaptable to all classes of work. They are manufactured of Peru porcelain, which is tough, strong and of high insulating qualities. The various styles of "Pemco" fuse rosettes are illustrated.

SEARCHLIGHTS, PROJECTORS, ETC.—Mr. Chas. J. Bogue, 213 Centre Street, New York, in a new catalogue of his products calls special attention to the many valuable improvements introduced in his electrical projectors and searchlights. The catalogue contains many illustrations of the different styles of projectors and searchlights manufactured by Mr. Bogue, and the principal features of each are pointed out in the descriptive matter.

THE KNEELAND REFLECTOR COMPANY, Boston, Mass., manufacturer of the Kneeland reflector shades, has removed from the factory on Friend Street to larger and much more convenient quarters at 104 Merrimac Street. This improvement in its facilities will not only increase the quantity of its output, but the increased storage room thus afforded will enable it to carry in stock at all times a full line of its shades in quantity, for immediate shipment.

PNEUMATIC TOOLS.—The Standard Pneumatic Tool Company has appointed as its Western manager Mr. James H. Manning, formerly master mechanic of the Union Pacific Railroad Company at Cheyenne. Mr. Manning's headquarters are in San Francisco. A very complete line of the company's "Little Giant" tools and appliances will be carried in stock in order to supply the rapidly increasing demand for these machines from the Pacific Coast.

DE DION-BOUTON MOTORETTE COMPANY, Brooklyn Borough, New York, has issued a 30-page price list of its motors and accessories. The machines and devices are clearly illustrated and their principal features described. The company informs us that its accessory business is increasing very rapidly, and that this department has been placed under the management of Mr. C. G. Wridgway. Mr. Wridgway conducted a similar business in Paris very successfully before he came to this country.

THE STAR DYNAMO WORKS, Jefferson City, Mo., are manufacturing a line of small and medium-sized electric motors and incandescent lighting machines. In addition to these the company makes a specialty of furnishing complete incandescent lighting plants, with directions for erecting, so that anyone with slight mechanical ability can install and operate such a plant satisfactorily. The company has complete lists covering the different standard outfits furnished by it which it will be pleased to mail to any one interested.

DYNAMOS AND MOTORS.—In a recently issued bulletin of the C & C Electric Company, New York, are described types "F P" and "F P E" dynamos and motors manufactured by this company. These machines are supplied in the open, the semi-enclosed or entirely enclosed types and their design is such that they may be placed horizontally, vertically or in any other position, and they may be belted, direct-connected or geared to their work. The bulletin contains perspective and diagrammatic views of these machines.

LARGE ENGINE.—One of the large engines being built by the Westinghouse Machine Company for the New York Gas & Electric Light, Heat & Power Company, was exhibited to local engineers at the company's shops at East Pittsburg a few days ago. This engine is of 6,000-hp and is one of eight of like size ordered by the New York Company. The height from the floor line to the top of the cylinders is 37¼ feet, and the diameter of the fly-wheel is 23 feet. This

is said to be the largest stationary engine ever built in America. It weighs about 1,500,000 lbs.

ERICSSON TELEPHONES.—The Ericsson Telephone Company, 296 Broadway, New York, has received a letter from the Chief Signal Officer, War Department, Washington, D. C., in relation to the uses of Ericsson telephones in that service. The letter states that in the early part of 1900 the Signal Office shipped a lot of telephones of six different makes to Manila for test purposes, and that the record of the Ericsson telephone has been favorable. The Department on Feb. 26 placed an order with the Ericsson Company for 200 bridging telephones to go to Manila.

THE UNIVERSALIST CLUB of New York City recently gave a banquet at the Hotel St. Denis. Among the addresses was one by a principal of the International Correspondence Schools, Scranton, Pa. The extensive interest felt by intelligent men generally, by students of economics and by educators in this remarkable educational institution was evidenced by the close attention of members of the club to an address lasting an hour. The speaker described the text books used by the schools, the method of teaching by mail, and answered numerous questions regarding the schools.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports business unusually good for the early spring season. Among recent orders are one 200-kw generator for the Laclede Gas Light Company, St. Louis, the third order within two months for the same size machines; a power and light plant for the Heer Shoe Company, Portsmouth, Ohio, including one 80-kw generator, and motors of various sizes; a plant to the Filston Dairy Company, Baltimore, consisting of a 37-kw generator and five motors, and five direct-connected motors to Benedict Bros., Baltimore.

THE GREEN ENGINEERING COMPANY, Western Union Building, Chicago, manufacturer of the Green traveling link grate, has issued a catalogue which is of considerable value to steam users, aside from its descriptive features. It has a long series of coal tables, giving the analysis, heat units and annual output of Pennsylvania coal by counties, Ohio coal by counties and seams, Illinois coal by counties, Indiana coal by counties, Eastern Kentucky coal by counties, and Western Kentucky coal by counties. It is a commendable piece of enterprise, and the catalogue will be prized by steam users as a reference book.

RUBEROID FLOORING.—One of the unique features of the equipment of the new offices of the Standard Paint Company, 100 William Street, New York, manufacturer of the well known P. & B. products, is the use of the P. & B. ruberoid flooring. The floors of the big offices are throughout covered neatly with this material. Ruberoid makes a pleasant walking surface, being elastic and not so resisting as wood or oilcloth, and deadening the ordinarily harsh sound of footsteps. It is said to be absolutely water, acid, alkali and vermin proof, and is easily kept clean, absolutely odorless and pleasant to handle. Handsome designs can be painted upon it. Its durability and economy make it a very desirable flooring for mills, factories, breweries, engine rooms, etc., while its neat appearance makes it desirable as a flooring for stores, offices, etc.

ELECTRICAL AND MECHANICAL EXPERT WANTED.—An examination of applicants will be held at the Navy Yard, Washington, D. C., May 17, for an electrical and mechanical expert in the Bureau of Yards and Docks, Navy Department. The pay will be fixed at $7.04 or $6.00 per diem, as the result of the examination may warrant. The examination will be open only to those who can give evidence of having received a degree in an electrical or mechanical course from an institution of learning in good standing, and who have since then had at least three years' experience in the design, manufacture or supervision during or after installation, of electrical machinery, etc. Applications should be delivered to the Commandant, Navy Yard, Washington, D. C., on or before May 16. Each applicant must give his name, age, residence, citizenship, present occupation and previous employment or work done.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has opened a Cleveland branch office and store in the Electric Building, from which point the company's rapidly developing business in Ohio and adjacent States will be taken care of. The office will be in charge of Mr. A. E. Barker, and Mr. H. B. Hanford, and probably others of the company's traveling force, will have their headquarters at the new office. The company intends to carry a full line of samples of all switchboards, telephones and other apparatus at the new branch. Among other important exchanges in Ohio, the Kellogg Company is equipping Ashland, Alliance and Canton, aggregating 5300 members. The boards used are the full signal light central energy boards, the same as have recently been installed in the Cuyahoga Telephone Company's sub-exchange at East Cleveland which was described in ELECTRICAL WORLD AND ENGINEER March 9.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., calls attention to its Bulletin No. 117, just from the press, descriptive of the S. K. C. indicating wattmeter and S. K. C. phase indicator. These instruments depend upon the dynamometer principle and are of the spherical coil type. No allowance has to be made in the reading of the wattmeter, as it is not affected by a leading or a lagging load of any power factor. It indicates power directly, or in other words tells what the engine is doing. The S. K. C. phase indicator facilitates the counteracting of leading or lagging load disturbances on a line by indicating the proper variation of the excitation of the synchronous motors connected thereto. At a glance it tells the condition of phase relation of current and e. m. f. Where motors and lights are supplied by the same machines this instrument is of great value. By its indications the regulation of the whole system may be materially increased.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that its spring business has opened up in a most gratifying manner, and every department of its business is rushed with orders. It states that it is meeting with unparalleled success in the introduction of its new J. M. standard junction boxes, and that wherever put in, these boxes have met with the greatest success, and that all contractors say that this is one of the most economical and best arranged boxes they have ever used. It is so built that it has a slate lined wiring pocket back of the tablet, and the entering wires can be brought in from any direction through the sides or back without difficulty. The tablet board can be easily removed without disturbing the box, and is not placed in position until all the building operations are completed. The boxes are made in two general types, one for surface work and one for concealed work. The company has got out a special bulletin covering these boxes, which it mails on application.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 30, 1901.
[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

672,913. ELECTROLYTIC CURRENT RECTIFIER AND CONDENSER; C. Pollak, Frankfort-on-the-Main, Germany. App. filed March 7, 1899. (See Current News and Notes.)

672,936. CONTROL OF ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed Aug. 28, 1900. (See Current News and Notes.)

672,939. ANCHOR FOR ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed June 16, 1898. The rod of rare earth is provided with a lug between its extremities to which a supporting wire is attached.

672,942. SYSTEM OF AUTOMATIC TELEPHONE EXCHANGE; A. E. Keith, J. Erickson and C. J. Erickson, Chicago, Ill. App. filed June 23, 1897. A simplification of the interconnecting circuits.

672,950. ELECTRIC MOTOR; F. A. Merrick and J. D. Ferror, Johnstown, Pa. App. filed Aug. 16, 1900. The shaft can be removed from the machine without disturbing either the armature or the commutator.

672,951. ELECTRIC RAILWAY MOTOR; F. A. Merrick, Johnstown, Pa. App. filed Aug. 21, 1900. Details for facilitating the connection and separation of the sections of the field magnet.

672,952. ELECTRIC RAILWAY MOTOR; F. A. Merrick, Johnstown, Pa. App. filed Aug. 21, 1900. A modification of the preceding.

672,959. ELECTRICAL CONNECTOR; H. E. Norris, Northeast, Pa. App. filed July 20, 1900. A bond having a protuberance at each end of less diameter than the terminal portions of the bond.

672,967. TELEPHONE EXCHANGE MECHANISM; H. P. Snow, Erie, Pa. App. filed Sept. 28, 1899. Series of incoming and outgoing line-wires; a series of groups of telephones connected with said wires, each group utilizing in common one wire with one of the series of wires for one side of their circuits, and a different wire of the other series for each telephone of the group, each series of wires containing a common wire for a group.

672,989. TRANSFORMER; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 12, 1901. An induction coil comprising a central coil, a series of coils arranged equi-distant apart and surrounding the central coil and means for making a magnet circuit around said coil.

672,992. CONTROLLER FOR ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed July 25, 1900. (See Current News and Notes.)

673,020. ELECTRIC PENDULUM CLOCK; F. Haenichen and O. A. Haenichen, Paterson, N. J. App. filed Jan. 10, 1900. The invention consists of an electric pendulum clock in which the impulse is imparted to the pendulum by the armature of an actuating electromagnet in connection with a weighted impulse rod and a current reverser, by which alternately currents of opposite polarity are thrown through the coils of the electromagnet for neutralizing the residual magnetism in the cores of the same.

673,039. TELEPHONE SYSTEM AND APPARATUS THEREFOR; A. T. M. Thomson, East Duluth, England. App. filed Oct. 9, 1899. In this system the subscriber communicates with the central operator by means of signals which are printed, thus avoiding communication through telephonic instruments and preventing central from hearing the conversation carried on between connected subscribers.

673,072. TELEPHONE METER; D. M. Bliss, Lowell, Mass. App. filed Oct. 1, 1900. A telephone meter located at the telephone instrument and provided with operating mechanism; a controlling circuit for said operating mechanism, and a circuit controller for said circuit operating in response to the operation of the signaling devices, said circuit controller being selectively influenced by incoming and outgoing signals respectively and adapted to remain in either position until again acted upon.

673,085. SAFETY SYNCHRONIZER FOR COUPLING INTO PARALLEL ALTERNATING CURRENT MACHINES; J. Pearson, St. Paul, Minn. App. filed Feb. 19, 1901. The combination with a rotary converter having direct-current leads and alternating current leads, of an automatic or self-closing switch in the alternating current leads, an automatic circuit breaker in the direct-current leads, and means independent of said switch and circuit-breaker for simultaneously tripping the same.

673,106. ELECTRIC ARC LAMP; S. H. Anderson, Pasadena, Cal. App. filed May 23, 1900. Details.

673,108. RHEOSTAT; A. W. Berresford, Westfield, N. J. App. filed June 12, 1900. A rheostat mounted on a circular base of insulating material provided with a row of teeth to act as detents for the arm and having suitable grooves to receive the material in which the resistance wires are embedded.

673,139. PORTABLE ELECTRIC FAN; E. R. Post and F. Wright, Newburg, N. Y. App. filed May 26, 1900. Details of a fan motor.

673,169. ELECTRIC ELEVATOR; N. O. Lindstrom, New York, N. Y. App. filed Feb. 4, 1901. Switch in the car by which it is possible to change the speed of the actuating machine, whether it be running as a motor or as a dynamo, and without the use of a rheostat.

673,172. MAGNETIC SEPARATOR; R. McKnight, New York, N. Y. App. filed March 15, 1900. A belt made up of magnetic material which is magnetized by running in proximity to a series of magnets arranged adjacent to a portion of its length, receives the crushed ore and carries the magnetic particles to one location and allows the non-magnetic particles to fall away at another location.

673,176. CLAMP FOR TROLLEY WIRES; J. W. Perry, Philadelphia, Pa. App. filed March 28, 1901. The end of a cross-over arm is provided with a laterally swinging clamp to grip and hold the wire in place.

673,186. MEANS FOR RETRACTING TROLLEYS; T. J. White, St. Louis, Mo. App. filed Dec. 26, 1900. Details of a spring ratchet device.

673,191. DEVICE FOR ATTACHING OR DETACHING ELECTRIC LAMPS; D. H. Arthur, Philadelphia, Pa. App. filed Dec. 27, 1897. Gripping jaws on the end of a rod are manipulated to attach or detach a lamp located in a remote position.

673,211. TELEPHONE APPLIANCE; M. London, McKeesport, Pa. App. filed Oct. 31, 1900. A bracket for holding the receiver.

673,219. DOUBLE RELAY CROSSING SIGNAL; B. N. Parrish, Jackson, Mich. App. filed June 30, 1900. Details.

673,222. STORAGE BATTERY; A. Reuterdahl, Providence, R. I. App. filed Aug. 9, 1900. An envelope containing the plate and the active material is inserted in a groove in the walls of the cell, thereby causing the envelope to press the active material against the plate.

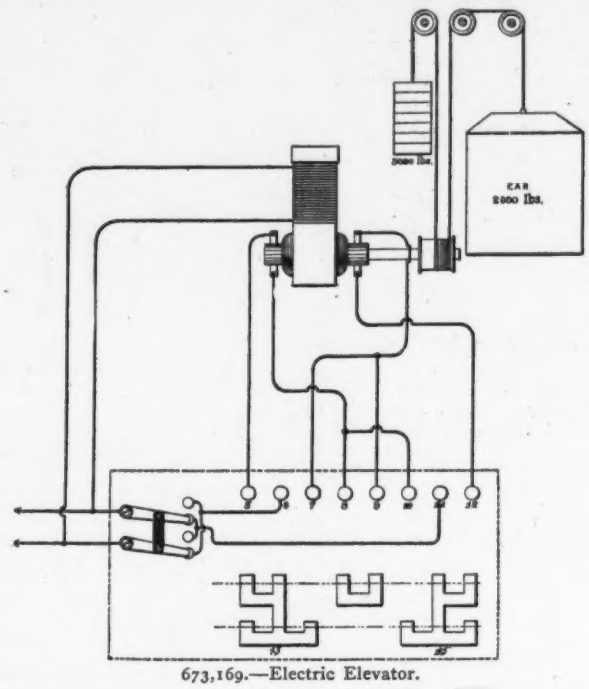
673,238. ELECTRIC SIGNAL; H. M. Buck and J. H. Love, Baltimore, Md. App. filed June 11, 1900. Details.

673,249. BASE FOR BATTERY CELLS; G. T. Eyanson and A. J. Shinn, Philadelphia, Pa. App. filed Dec. 4, 1900. A base piece for battery cells, having long channels through which liquid may be made to flow to the interior of the cell, the said channels being small in calibre so that the liquid therein will be of high resistance.

673,266. BOOSTER REGULATING SYSTEM FOR STORAGE BATTERY CIRCUITS; A. S. Hubbard, Belleville, N. J. App. filed March 2, 1901. The booster has its armature connected in circuit with the battery and its field magnet energized by circuit connections responsive to variations of battery potential to cut down the battery current on excessive variation in either direction.

673,315. PRINTING TELEGRAPH; G. A. Cardwell, New York, N. Y. App. filed Nov. 18, 1899. An electrical apparatus for printing or other purposes, comprising a number of working circuits or branches each, including a working magnet and having at least three breaks or gaps, controllable magnets each responding to a characteristic kind of impulse, sets of switches operated by the controllable magnets and each set closing breaks in different working circuits, but not all the breaks in any one working circuit and the operation of particular sets of switches in a certain order of three at the least, closing all the breaks of a particular working circuit.

673,344. TELEPHONE SWITCH AND CUT-OUT; P. J. Wendell, Opheim, Ill. App. filed April 18, 1900. The object of this invention is a switch

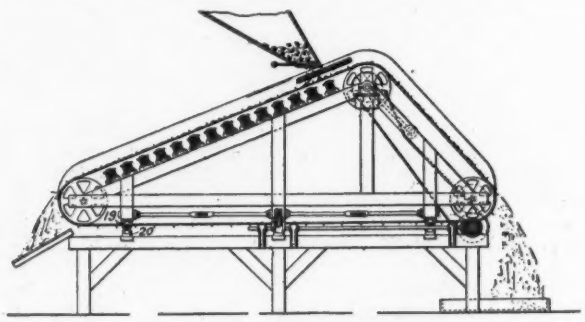


673,169.—Electric Elevator.

and cut-out whereby a telephone in the circuit may be completely cut out and the circuit be shunted past the telephone without interrupting the work of the other telephones in the circuit, or the telephone may be cut out from either direction while kept in circuit with all the instruments in the line in the opposite direction, and this without destroying the operativeness of the portion of the circuit from which it is cut out.

673,348. ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed March 13, 1901. To attain certain objects the invention comprises a connection which includes the proper resistance and one or more cells of battery, and which is connected with the brush of the booster in such a way that it co-operates with the series field of the generator.

673,350. TELEPHONE TRANSMITTER; C. E. Tocom, New York, N. Y.



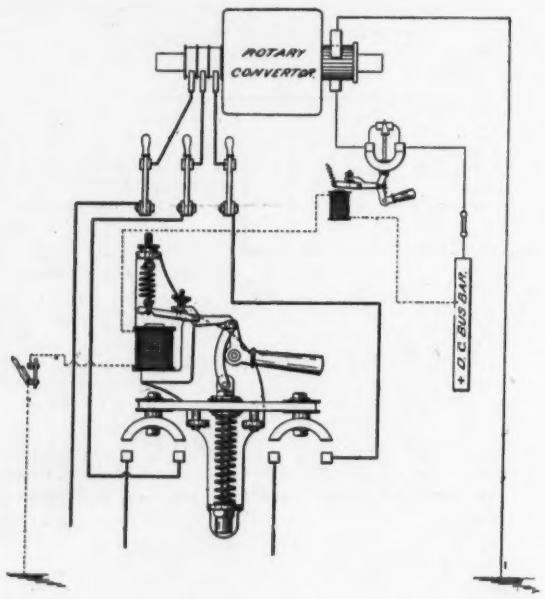
673,172.—Magnetic Separator.

App. filed Feb. 4, 1901. Three diaphragms are used, granulated carbon being confined between the middle one and each of the others by soft textile material.

673,364. PROCESS OF THE PURIFICATION OF ALUMINUM; W. Hoopes, New Kensington, Pa. App. filed Sept. 1, 1900. (See Current News and Notes.)

673,368. TROLLEY STAND; F. Pfent, Conners Creek, Mich. App. filed June 27, 1900. Details relating to the spring mount.

673,372. VOLTAGE REGULATOR; P. S. Tirrill, Groveton, N. H. App. filed June 27, 1900. A claim describes the invention as follows: In a voltage regulator, the combination with a solenoid-coil connected in multiple arc to the supply wires, and a core and sustaining-spring; of a double contact lever connected to the same, a torsion spring forming a fulcrum-mount for the lever, an upper and lower contact, a double solenoid core, one portion of which is connected to one of said contacts and the other portion to the other contact, and each being thereby thrown alternately into the circuit of the supply wires and an automatic rheostat connected to and worked by the core of the double solenoid, said rheostat being in the circuit of the dynamo field magnet.



673,085.—Safety Synchronizer for Coupling into Parallel Alternating Current Machines.

673,274. ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, New York, N. Y. App. filed March 27, 1899. In a circuit controller, the combination of two movable switch members for controlling the same circuit, and two electro-responsive devices for controlling said switch members, each switch member and its electro-responsive device operating automatically and independently of the other to affect the same circuit, one when excessive current flows and the other upon failure or abnormal decrease of current.

673,277. INCANDESCENT ELECTRIC LAMP; J. E. DeMarcay, Paris, France. App. filed Nov. 8, 1898. (See Current News and Notes.)

673,286. ELECTROMECHANICAL EMERGENCY BRAKE FOR TRAM CARS; E. V. Planta, Lucerne, Switzerland. App. filed Jan. 10, 1901. Skid shoes are allowed to drop from the rails in front of the wheel whenever the motors are thrown onto a closed short circuit.

673,287. STORAGE BATTERY; A. Reuterdahl, Providence, R. I. App. filed Oct. 10, 1900. Details.

673,289. SUPPORTING FRAME FOR RELAY MAGNETS; U. S. Rogers, New York, N. Y. App. filed Feb. 28, 1901. Details of construction.

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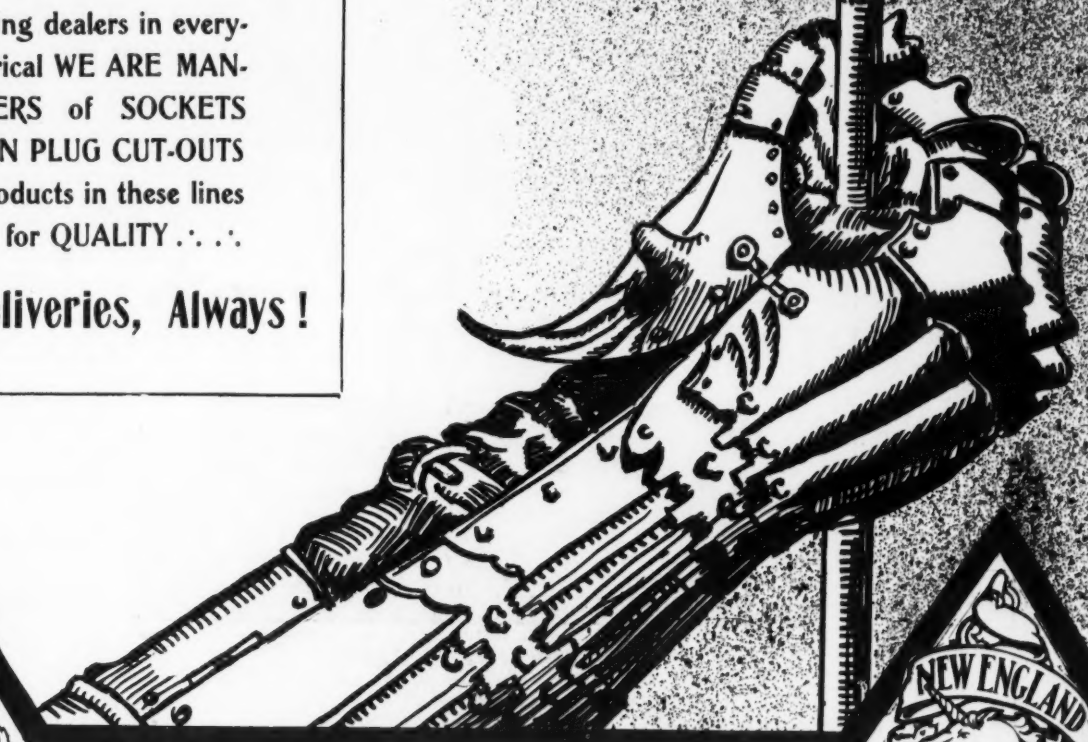

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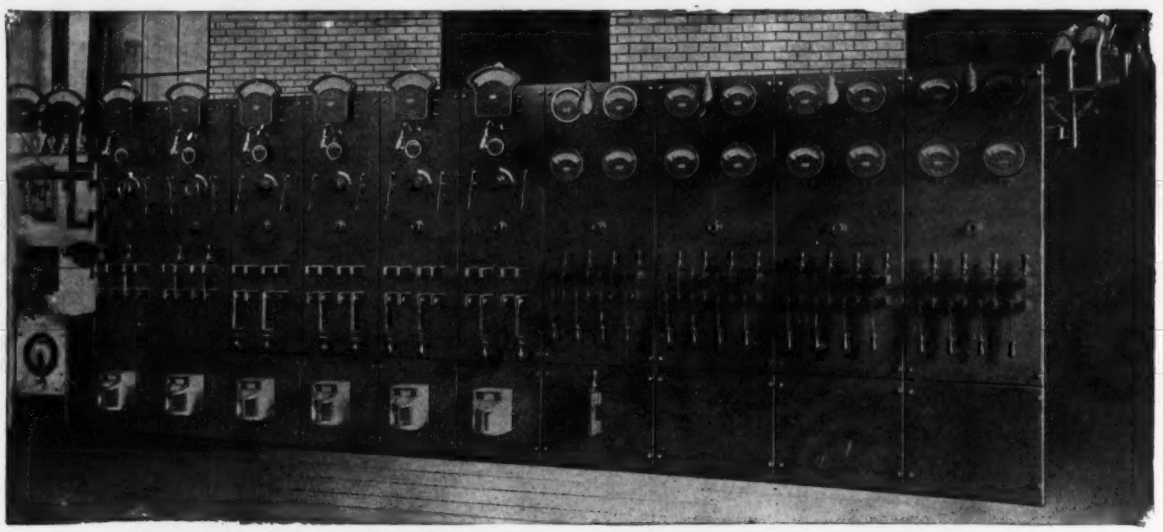

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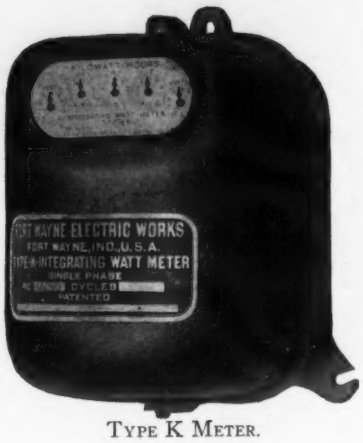

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